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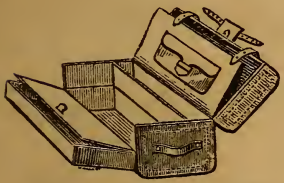

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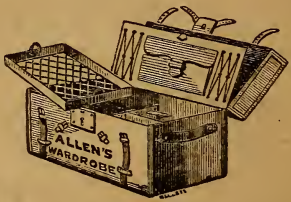

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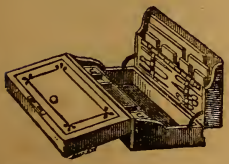

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THE INFLUENCE OF

RAILWAY TRAVELLING

ON UBLIC HEALTH.

THE INFLUENCE

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RAILWAY TRAVELLING

ON PUBLIC HEALTH.

FROM "THE LANCET."

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INTRODUCTION.

The important relations of Railway Travelling to Public Health have long attracted the attention of thinking men, and especially of the Medical Profession. The proprietors of *The Lancet*, anxious to procure for the public and the profession sound information in lieu of vague surmises on this subject, appointed recently a scientific commission to conduct an inquiry into the influence of Railway Travelling on the Public Health; and the result of their labours is here printed in a complete form. The assistance of the most able members of the Medical and Engineering Professions has, it will be observed, been freely given; and it may fairly be said that in this Report are epitomized and digested all the ascertained facts which bear upon the question. The publication of the successive Reports was followed with so general and deep an interest, that it became a duty to present them in a collected form.

London, *June*, 1862.

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nasty scents? Is it for a man's health to be laid fast in foul ways, and forced to wade up to the knees in mire,—to travel in rotten coaches, necessitated to bait or lodge at the worst inn on the road?"—and so on until the writer had made a case sufficient to demand the immediate suppression of stage coaches. With custom and after experience the influence of coach travelling on health and comfort came to be very differently estimated. Pennant says the coaches of his time (1739) were fitted for the conveyance of "the soft inhabitants of Sybaris;" and a scientific dictionary* (1763) says, "at present they seem to want nothing either with regard to ease or magnificence." Yet some thirty years after this, when the late Lord Campbell first travelled by coach from the north to London, he was gravely advised to stay a day at York, as the rapidity of motion (eight miles per hour) had caused several through-going passengers to die of apoplexy.

Threatened Dangers of Railroads.—The dangers from railway travelling with which the public were at first threatened were innumerable. The immense velocity (for some rash speculators had hinted at a pace of twenty miles an hour) was fraught with danger to the respiration, and the carbonic acid generated by the fuel when passing through long tunnels would inevitably produce suffocation by "the destruction of the atmosphere."† Tunnels would expose healthy people to colds, catarrhs, and consumptions.‡ Boiling and maiming were to be every-day occurrences. And numbers of less demon-

* A Cyclopædia of the Arts and Sciences. By a Society of Gentlemen. 4 vols.

† Dr. Lardner. ‡ Sir A. Carlisle.

strative people looked on the suggested innovation either as a wicked tempting of Providence, or a wild scheme too visionary to be worthy of serious consideration.

Materials and Purpose of Present Inquiry.—We have outlived the time of these prejudices. We have reached a period when loose inferences and vague surmises should no longer be permitted to usurp the place of exact knowledge. For the immense collection of facts and data already made in reference to railways, and the experience accumulated by the rapid development of railway travelling, supply materials abundantly sufficient to justify a systematic inquiry into the influence on health of railway travelling, with reasonable prospect of attaining reliable results and determining many harassing doubts.

Medical men are often asked whether they consider railway travelling prejudicial to health. Usually some case is cited on which the question is made to turn ; precision as to history and symptoms being more or less disregarded. But the very frequency of the interrogation points to the same conclusion which careful inquiry has led us to form—that there has been gradually growing up in the public mind a suspicion of dangers from railway travelling widely different from that apprehension with which the thoughts of travellers were at first uneasily possessed. It is no longer the fear of accidents so much, as a vague dread of certain undefined consequences to health resulting from influences peculiarly produced by this mode of travelling ; and we find that those little likely to form decided opinions without careful inquiry share this feeling, and do not hesitate to express it. In his evidence before a Committee of the

House of Commons in 1859, Lord Shaftesbury said, "The very power of locomotion keeps persons in a state of great nervous excitement, and it is worthy of attention to what an extent this effect prevails. I have ascertained that many persons who have been in the habit of travelling by railway have been obliged to give it up in consequence of the effect on the nervous system. I think that all these things indicate a tendency to nervous excitement, and in what it may issue I do not know." In the course of this inquiry, it is proposed to consider the evidence on which rests the prevailing public opinion very fairly represented by the remarks of this careful observer.

It is due, however, that we first mention the actual amount of railway travelling according to the latest estimates, and then consider the extent of those immediate dangers to life and limb usually grouped under the common term of railway accidents; in order that these may not interfere with subsequent considerations as to other influences of railway travelling, apart from the immediate risk of personal injury.

Present Extent of Railway Travelling.—There are now about 11,000 miles of railway, mostly double lines, in operation in Great Britain; equivalent to the total length of all the railways in the rest of Europe, according to the last returns. The number of individual journeys undertaken in the United Kingdom has increased, during the last ten years, at the rate of nearly ten millions per annum. The distance now daily travelled by passenger-trains would circle the whole world six times. The separate journeys made during the year 1860 amounted to 164,633,028, the average

length of each journey being rather more than fourteen miles.*

The Time Saved.—The saving of time by railway as compared with the best of other modes of conveyance is about one hour in each twelve miles. And so, in the course of a twelvemonth there is added to the available time of the community a period of upwards of 20,000 years; or, in other words, there is a number three times as great as this added to the effective working population of the country, reckoning eight hours as the work-time in each day. Certain reservations must, however, be borne in mind so far as these figures are concerned; since journeys now rendered easy by rail would never have been undertaken but for its facilities. Allowing the widest margin for this and other exceptions, there still remains a clear annual saving, which may be reckoned by hundreds of years; and this has an indirect bearing on the subject of public health which may be here alluded to.

Social Changes.—For people in the present day do more work, with less recreation, or provision of rest for the mind, and exercise for the body, than at any previous time. In the middle ages, the number of feasts and holidays ordered by the Church or established by custom ensured many days in the year when no business was thought of. In large towns, it was the duty of citizens to encourage and join in athletic games and exercises, for which certain hours were set apart, and

* These figures are calculated on the lowest estimates. As no account is kept of the number of separate journeys made by season-ticket holders, these have been estimated, after careful inquiry, at twenty-five each ticket. The average length of the journeys in 1854 was computed at twelve miles. The increase is probably attributable to the development of excursion traffic.

which inured men to resist the influences of cold, of discomfort, and even of disease. In London, occupations of this salutary kind were solemnly enjoined, and, from the account of Stowe,* must have absorbed a considerable amount of time. In the eighteenth century, general holidays and festivals decreased in number, and public exercises were gradually discontinued. But, even then, a journey by horse or coach, tedious and uncomfortable as it now seems, had yet the advantage of affording a period of rest from anxieties whilst on the road, and of physical exercise or motion in the open air; the mind being necessarily diverted by the personal incidents of the journey. With the increase of railway travelling, and the greater facilities for transaction of business which rapid communication affords, there has been a corresponding change in the habits of the people, a devotion of more time to the work of life, and a neglect of means adapted to ensure vigorous and resistent physical health.

For that important social change during late years, a progressive increase in the number of the members of the middle classes,—a change which is in great measure attributable to railways,—affords the means of avoiding many of those unhealthy influences with which a worse clothed, worse housed, and worse fed population had formerly to contend. There is strength and stamina sufficient to get comfortably through life, but very little of that surplus physical health which we have named resistent. There are the means to fly, but not the power to fight. And so, when a warning comes that the energies of the mind or the endurance of the body have been overtaxed and broken down, it not unfre-

* Survaye of London, 1598.

quently happens that the real source of mischief is disregarded, the *post* and *propter* are confused, and the disastrous result is attributed to some cause of really secondary importance. This consideration should especially be borne in mind in all cases where impairment of health is attributed exclusively to the influence of railway travelling.

RAILWAY ACCIDENTS.

The information possessed as to the extent and character of accidents occurring on railways is very precise, while other means are available for comparing them with accidents from other modes of travelling. The passenger-trains of the United Kingdom travelled over nearly 50,000,000 of miles in 1859. In 1860, the distance had increased to 52,816,579 miles. The number of railway accidents in four years was as follows:—

Year.	Accidents.	Killed.	Injured.
1857	62	26	657
1858	56	35	467
1859	56	13	386
1860	68	37	515

In the metropolis alone there were 70 persons killed and 910 injured by coach and carriage accidents in 1859. In Paris, the numbers in 1860 were 30 killed and 579 injured.* The average number of deaths in coal-mines in this country is 1,000 per annum,† and it is calculated that a British vessel is wrecked in each tide throughout the year. Here is proof sufficient of the comparative

* Revue Contemporaine. † Quarterly Review, Oct. 1861.

safety of railways compared with other modes of travelling and with other conditions of life in which the individual does not rely on himself for security.

Average Risk to Travellers.—Furthermore, it is readily seen what is the average risk to each individual traveller. Of persons killed by railway accidents in the United Kingdom, the proportion to the whole number of travellers was, in 1854, 1 in 7,195,342. In 1860, it was 1 in 5,677,000. In France, it was 1 in 7,000,000. In Belgium, 1 in 8,860,000. In Prussia, 1 in 17,500,000 of all travellers. The proportion of persons killed whilst travelling by diligences in France was 1 in 335,000—about equal to the proportions of both *killed and injured* on English and French railways. On the railways of the United States these amount, however, to 1 in 188,000; but there the cost incurred in constructing the lines is two-thirds less than on European railways.

An unrecognised Cause of Danger.—Railway travelling, then, as at present conducted, is more free from actual danger to life and limb than any other mode of conveyance. But the returns which show this, also help to prove something more. It would be beyond our province to discuss all the causes which endanger the safety of travellers by rail, for this would involve entering into all the details of railway management. But after long and careful investigation, we deem it right to direct attention here to one source of danger so little known to the public that not even the continual recurrence of accidents clearly traceable to this source has as yet aroused attention to this increasing cause of risk.

Collisions.—Of the whole number of railway accidents (242) occurring during four years, 149 were due to collisions. Of 2,136 deaths and injuries in the same time,

1,643 were attributable to collisions. In the last six months of the year (during the time when irregular or excursion trains run), the number of collisions was 93, as compared with 56 in the first half of the year.

Causes of Collisions.—At any given time, and in the most perfectly appointed train travelling on the most exactly laid line, the lives and safety of the passengers are in the keeping of three men, on whose clearness of head, knowledge of their business, and command of all their faculties, everything depends. These are the signal-man, the engine-driver, and the guard. It is therefore a matter of vital importance that every possible precaution should be adopted to insure that each of these men, when on duty, is at all times in fullest possession of those qualifications essential to the safe conduct of the train.

Were this always the case, it is difficult to understand how a collision could possibly occur. If he did not know his business, he should not have been appointed; if he would not attend to it, he was guilty of manslaughter if death ensued. But if he could not do his work, and that through no fault of his own—how then?

Suppose that men, wearied out by long journeys and exhausted by fatigue and want of sleep, are ordered, on pain of dismissal, to undertake immediately fresh duties for which they are rendered incapable by previous exhaustion of body and mind. Would it not then appear little short of miraculous if some accident did not result? The worn-out engine-driver nods, and a hundred lives are in jeopardy; the signal-man, dazed by want of sleep, becomes confused, and in a moment the engines are pounding up human beings between them. The acute faculties of the guard are blunted by long unrest, the danger-signal passes unnoticed, the break does not second

the efforts of the alarmed engine-driver, and next morning there is recorded in the papers another railway accident.

The supposition suggested and these illustrations of accruing results may appear exaggerations to those who for the first time consider this subject; but careful inquiries have afforded us convincing evidence that the system of railway management, so far as concerns the duties of guards, engine-drivers, and signal-men, evinces very little regard to those particular conditions which we have mentioned as essential to render trains ordinarily safe from risk of collision. It is only necessary to cite a few cases by way of illustration, preferring those which have appeared in public print; since the majority of direct personal communications made to us were in confidence—for obvious reasons.

When the collision occurred in a tunnel on the Brighton line last August, the signal-man stated in evidence, "I went on duty at eight in the morning, and should have remained on for twenty-four hours. Twenty-four hours I consider as a hard day's work. I am always glad when it is over—I know that." A letter in the *Times*, *à propos* of this, mentions that a signal-man at Brighton had been thirty consecutive hours on duty.

In the collision which occurred shortly after on the North London line, the signal-man stated that he was on duty when the accident occurred from seven in the morning till ten at night.

On another line, a most intelligent guard informed us that on one occasion he was for forty-six hours without taking his clothes off, and during this time in charge of passenger-trains, having only an hour and a half's rest. He believed that he was not equal to his work during the last hours, being dead beat.

An engine-driver on a fourth line said that he had been thirty-six hours on his engine without any interval, taking his meals on the way; acknowledged that few men could stand this; he did not regularly sleep at all during the time, but had a "sort of dog-sleeps;" often had from sixteen to eighteen hours a day on duty for four and sometimes six days a week.

A guard on another line said he had been three days and two nights constantly in charge; and a responsible official on the same line, having peculiar opportunities of obtaining information, testified that this system of imposing extra and unexpected work on the men very generally prevails.

It might be supposed that these are exceptional instances during unusual traffic pressure. But this is not so; and even were it the case, would afford no excuse. For it were far better not to start a train than to send it forth under the charge of wearied men unequal to their duty, and at such risks as we have described.

Fairly worked, there are few operatives so intelligent and trustworthy as railway officials. But they are men, not machines. They have no alternative but dismissal if they demur to orders from superiors, and it is a rule on railways that the last order given is to be obeyed. If dismissed, they have no appeal. There are plenty to take their places, for the pay is good enough to be attractive in the over-stocked labour-markets of the present day—porters anxious to become guards, firemen ambitious to become drivers. They have appealed to the directors on several occasions without results, and even now a protest is being prepared on the subject. As it is, they

have no alternative but to do as they are bid, and we all know that sooner or later discontented men cease to be trustworthy servants.

Not only is the endurance of the men occasionally over-strained to a dangerous extent, but on some lines a regular system of overwork of a most injurious kind has been introduced. The guards are paid by time when on duty; they are thus induced to work for sixteen or eighteen hours a day for four or five days a week, resting on the other days, and receiving no pay; or work the same number of hours during three weeks, and have shorter time on the fourth. The engine-drivers are paid by the trip, with the same result, practically ensuring a temptation to earn extra pay by over-work. Again, it is a rule that men sleeping from their homes have a small allowance as bed-money. To save this, one of the railways has recently directed that the guards of one route, after travelling nearly two hundred miles, shall return the same day, and without any interval of rest, in charge of another train.

We select these particulars from a large number of similar cases, to indicate where blame must lie for proceedings so unjust to the men, dangerous to the public, and injurious to the interests of the companies. For exemption from danger under circumstances such as we have described must tend to make men over-confident or careless, and this must lead to accidents. The impolicy of the present system seems sufficiently evident; but the reports made from time to time by the official Government inspectors do not indicate much likelihood of reform by railway executives, who "seem to prefer the risk of paying enormous sums of money-compensation

for accidents and damage, to attempting any improvement." *

The remedy is the simple one of fixing a maximum time of work. It has already been found necessary to adopt this system for post-office officials travelling on railroads, who are not permitted to exceed a certain number of hours on duty. If such a regulation be found necessary for the work of sorting letters, it is tenfold more needful where the lives of passengers are at stake. It is a duty devolving on Government to provide the remedy and compel attention to it. "A Government which neglects enforcing precautions of this sort neglects one of its most important functions, and allows the lives of those whom it is bound to protect to be endangered or sacrificed by the cupidity, ignorance, or carelessness of the managers and servants (how incompetent soever they may be) of every railway association in the kingdom." †

CONSTRUCTION OF RAIL AND CARRIAGE.

Before alluding to the personal influences experienced when travelling by railway, it is expedient that we describe the conditions of rail and carriage concerned in producing these results. It is especially important that the causes and character of the motion experienced in all railway travelling be clearly understood. For the following original and lucid report on this subject we are indebted to Mr. W. Bridges Adams, the eminent railway engineer :—

The Motion.—That certain influences on health are

* Report of Inspecting Officers upon Railway Accidents. March, 1861.

† M'Culloch's Dictionary of Commerce, 1859.

The sounds produced from a violin are a result of friction; *i. e.*, a succession of minute blows produced by the leaping from particle to particle of the powdered rosin which adheres to the horsehair of the bow. This is easily proved by applying grease to the horsehair, when all sound ceases. Sound is vibration; vibration is minute concussion—mischievous in proportion to its regularity and continuance.

Why, then, is there more friction on the rail than on the road? Simply, that on the road wheels are used; on the rail, in lieu of four wheels, a pair of garden-rollers are used, the wheel and axle moving solidly together. Now a garden-roller will only move forward in a straight line; and the agricultural instrument-makers who construct revolving clod-crushers find it necessary to divide their rollers into a great number of separate discs, or the friction would overpower the horses. If railway wheels were applied to omnibuses or road waggons, the horses would not be able to draw them a mile. A Frenchman once tried the experiment here in England (in pursuance of a patent he had taken) by applying a pair of wheels fast on the axle to a gig, with the axle revolving. The result was the same as that of the rustic car of Spain and Portugal—a horrible noise and friction, and destruction to the horse. But these railway wheels or rollers do move on railways, and at two or three miles an hour they move with very little noise or friction, but this *mobilitate viget viresque acquirit eundo;* at ten miles an hour the change is recognizable; and the greater pace, the more trying becomes the motion experienced by passengers.

Railways consist of straight lines and curves. But the so-called straight lines are not straight relatively to

the action of the wheels, and the curves are not merely regular curves as designed by the engineer. In truth, the whole railway, *quoad* the bearing of the wheels on the rails, is a series of irregular curves.

The Wheels.—Ordinary road-wheels are conical on their peripheries, and induce friction; but the friction is not incessant, and only takes place when bearing equally over the width. Moreover, the surface on which they roll is more or less yielding, and vibration does not pass unbroken through the wheel to the vehicle. Railway wheels are also conical on their peripheries, but as they bear on a hard surface the vibration is considerable. The object of making them conical is to compensate for the absence of independent movement in each wheel when on curves. If the two wheels fixed on each axle be of equal diameter, they will roll forward in a straight line. When on a curve, at a given speed, the centrifugal force causes the vehicle to hug the outer rail, causing the outer wheel to turn on an increased diameter, and the inner wheel to turn on a decreasing diameter. But if the speed varies the result must be unequal, and friction must go on; and although with a single carriage at low speed the carriage may roll with little friction, it is obvious that this can only be accomplished by lateral deviation of the vehicles from the regular line of traction. With increase of speed there is no time for lateral deviation, and a sledging movement along the rails is substituted for a rolling one.

The rolling movement over a series of irregular surfaces induces that lateral oscillation which is so unpleasant to passengers. To prevent this, the carriages of passenger-trains are closely coupled together; but the tendency still exists, and the wagging of the last joint of the tail

—the break-van—expresses it. The probability is, that from a fourth to a sixth of the whole movement is sledging, increasing with the velocity. In this mode a great amount of surplus power is required, rising from the four pounds of axle friction to the seven and eight pounds of wheel friction, up to twenty-five and twenty-eight pounds per ton. If the vehicles of a luggage-train were as close coupled as those of a passenger train, the engine could not move them at all; therefore they are loose-coupled, and the first operation of the driver is to back the whole of the vehicles one on another, and then to start them in succession. If a goods-train going at very slow pace be watched from a bridge, it will be seen to oscillate, the wheels seeking the path of least friction. If the pace be quickened, the movement lessens whilst the jolting increases.

But if, in addition to the differing diameter of the wheels on the varying surface of the rails, the vehicles be badly constructed—*i. e.*, the wheels be out of plane with each other, or the axles be not parallel, the vehicle ceases to be a rolling body and becomes altogether a sleigh. Goods-trains have been known which would not roll down a slope of 1 in 75 without engine-power, and passenger-trains may be in the same condition if neglected. When the wheels sledge on the rails by reason of irregular pathway, a very heavy torsion of the axle takes place, which increases; in fact, a torsion of the wheel enormously increases the vibration and the risk of breaking both axle and wheel-tires.

The Rails.—These remarks have reference to the action on the peripheries of the wheels; but there is also an effect which is produced on the rail on which it travels. The train is guarded by the action of the side flanges,

and not by the tractive power. As the flanges approach the rail there is a constant succession of blows of more or less violence, analogous to the jerks experienced when a vehicle is driven along the edge of the kerbstones in the streets.

THE LIFE OF THE RAIL.—It was originally supposed that—less the condition of rust—rails would last from twenty to thirty years. But the data were imperfect. The calculation was based on a weight of engine and train that would not crush the rails, and on there being a true rolling movement. Practically, rails have lasted fifteen years under peculiar circumstances; but under present conditions they are worn out in from three to six years. These conditions are, the enormous weights on engine wheels, crushing the rails into fibres, just as a piece of wood is crushed under a heavy load; and the increase of sledging movement consequent on augmented speed. Let the weights be lessened to the bearing power of the iron, and let the sledging be converted into a perfect rolling movement, then there is no apparent reason why the rails should wear out until destroyed by oxydization. If any one doubts the fact of the sledging, let him look at the glint or burnish on the rail surface after the passage of a train on a fine sunny day. Metal-workers know that burnish is not induced by rolling, which is a mere transference of surfaces, but, by sliding, which is an abrading or grinding of surfaces. If two grindstones of equal diameter and hardness were set in motion, with their edges in contact, they might move on for an indefinite time without attrition; but make one move faster than the other, wear and destruction immediately take place. The gur-r-r-e of the railway train, heard a mile off, is neither more nor less than a process of grinding.

Try an experiment. Take a portion of polished rail, say 100 yards in length, when glistening in the sun on a bright day. Clean the surface perfectly with a cloth, then test it with the finger after the passage of a train, and it will be found blackened with iron powder. Only a sledging movement forward, or laterally, or diagonally, can produce this effect, and in producing it, vibration and noise are the result, precisely as the rosin on horse-hair produces vibration on tension strings.

The reasoning hitherto is applied to railway wheels in their normal condition with conical peripheries. In order to diminish the destructive action on the rails and tires, the rails are pitched to such angle as to be vertical to the cone. Thus the engine-wheels obtain adhesion by friction, as the whole breadth of the surface is moving at different rates of speed. This friction is useful to some extent, but it is destructive also ; and when the wheels of the train bear in the same mode over the whole breadth of the rail, the retarding friction and wear become very considerable. Theoretically, to induce the least possible friction the bearing on the rail should be a line, but this supposes a material of indefinite hardness and strength, capable of bearing without surface — a mechanical condition not yet attained. And so the rails flatten out irregularly, the wheels get worn into grooves, and then increased jolting and destruction take place. The wheels do all they can in conformity with the laws of matter to seek the path of least friction, inducing lateral movement at each curve of the rails, but their efforts are counteracted by bad mechanical arrangements.

The perception that something is mechanically wrong is wide-spread. But they who should remedy the evil will not begin at the beginning; they continue to

assume that "railway wheels are perfect;" and just as there was once a battle as to the breadth of gauge, so there is now a contest between rigidity and elasticity in permanent way. Truth lies between. In the imperfect condition of engines and trains, a rigid way soon goes to pieces, and therefore yielding must be provided for in the way, if disregarded in the vehicles. In all motion there must be elastic resilience, or destruction will ensue. Friction is an impediment to movement, and elasticity must be afforded to yield to the obstacles which will not yield to the moving body. In passing over the earth's surface in a balloon, we have no sensation of wind or friction, because we move with the wind and there is no sound; but fixed objects opposed to the wind induce noise and vibration by resisting it. The resistance of rails to wheels occurs in many ways. If we look at the rail surface, we find that the polish caused by the wheel marks a sinuous line, sometimes in the centre, sometimes on the outside, and sometimes on the inside of the rails. Unless when quite new there is no such thing as a straight line of bearing, and when at full speed the wheels have not time to follow the small curves. Then, again, the joints are imperfect; they do not fulfil the required condition of making the rails a continuous bar of equal strength.

The Bed of the Rail.—But worse than all this is the mode of fixing the rails to the sleepers. The early railway makers fixed the rails on cast-iron chairs, or seats, on stone blocks, which, at eight miles per hour, answer still. But increased speed destroyed rails, chairs, and blocks, and so wooden sleepers were substituted for stone; what was called "temporary way" proving more durable than the so-called "permanent way." The reason

is obvious: the loose movement induced by bad structure was found less destructive on a wooden anvil than on a stone one.

English rails are made what is called double-headed, in order that when the top is worn down, the bottom may be turned up and used as a new rail. To fix them they are placed in cast-iron chairs or seats, which fit the lower rail surface, and are confined there by a wooden key or wedge. With the springing of the rails under the loads, these keys get loose, and the rails dance up and down on the cast-iron anvils, called chairs, adding very materially to the vibration of the vehicles, and rapidly destroying the rails and wheels. The joints are what is called "fished," but the fishes or pieces of metal do not represent more than one half the strength of the solid rail, and so the joints work loose. When the rails are worn out on the top, they are commonly found on reversal to be notched on their surface to the depth of an eighth of an inch where they lie on the chairs; and as the top level has altered its form, it is impossible for the rail to lie at rest. Those who have ridden over newly reversed rails do not therefore wish to repeat the experiment.

In animal bodies the means of motion are muscle and tendon. Tigers or cats can leap from many times their own height without damage. A railway engine or carriage would be destroyed by a very small fall. Removed from the rail to a paved road, either it or the road, or both, would be rapidly destroyed. The reason is that there is great deficiency in the mechanical appliances which should represent muscle. If a malformed man has one leg shorter than the other, he can compensate for the difference of radius by more or less of muscular action. No

such compensation is found in railway vehicles. Again: a horse works over hard pavements for years, saving the jolts by the action of his muscles and tendons. After a time his tendons lose their power, and his footing becomes uncertain. The veterinary surgeon interferes and rehardens and tempers his springs or tendons by the process which is called firing. The railway carriage, even at the outset, is in the condition of a worn-out horse. It is as a framework of bones without muscles.

There is yet a further difficulty. The rolling of the wheels crystallizes the iron of the rails, which, when reversed, is found to have lost its normal strength; and for this reason the officers of the Board of Trade denounce the practice of reversing the rails as being unsafe.

There is no difficulty, and certainly no need of increased expenditure, in constructing a line and train nearly free from oscillation and vibration; but mechanical laws must be obeyed in so doing. In such case railway travelling might be reduced nearly to the condition of balloon travelling, and it would become a healthy exercise instead of an unhealthy vibration.

What are the obstacles to it? First, that the existing lines, with their heavy traffic, are not adapted for it; as it is impossible to preserve a line in good order with the heavy engines. By "heavy engines" is not meant the amount of tonnage on the machine, but the pressure on the individual wheels. Thus a twenty-ton engine on four wheels may be practically a heavier engine than a thirty-ton on six, if too great a load is placed on the driving wheels.

The next obstacle is the unfair condition in which the officers of railways are placed. If an accident happens, they are made responsible by a jury, and are absolved

from blame if they have not departed from any existing practice, and have paid the highest price for their materials. If they have departed from existing practice, however demonstrably superior the new may be, the chances are that the jury will visit it on them as a crime.

The third difficulty is the alteration of existing stock, and the cost of improving permanent way before already existing way is worn out. The latter difficulty is certainly not insurmountable, as the wearing out is rapid enough.

There is a fourth difficulty. Almost every alteration in stock on one line interferes more or less with other lines on which the stock runs.

But the first thing to do is to settle the quarrel between wheel and rail, which, as Stephenson said, should be as man and wife, but at present are a very ill-assorted couple. All other improvements are comparatively valueless as regards the influence produced on passengers, till this improvement shall have been carried into effect.

Motion in Carriages.—The existing railway stock in this country is now represented by upwards of a quarter of a million of vehicles. If joined into one long train, with their 5,800 engines (consuming 260 tons of coal per hour), they would form a continuous line of about 600 miles; sufficient to join the extremest points of Britain.

Of this vast number, 15,076 are passenger carriages and all these are practically alike in everything except their internal arrangements. Now as the waggon-part, or bed, of all passenger-carriages (including the wheels and springs) are similar in construction, it follows that, contrary to general opinion, the amount of motion is the same in all classes, and is that originally due to the bad understanding between wheel and rail; as already ex-

plained in the report of Mr. W. Bridges Adams. But the character of the motion conveyed to the passengers in each class varies considerably, as most travellers know, and hence they incline to believe that the *amount* of motion also differs.

Trucks.—Riding on an empty railway truck, loose coupled, with short springs, and having no buffers, conveys to the passenger a very accurate account of every inequality and irregularity of the line, or defect in the wheels. It is thus that every new line should be tested and every old line judged ; the amount of motion in different distances being mechanically gauged. At present the system of inspection seems greatly deficient in exactitude. It is very rough riding on the rail in such a conveyance, "shaking the very life out of you," as the phrase is, by a series of sharp, vehement bumps, with irregular, but notable intervals. These represent what is felt by every vehicle passing over the line, and represent also the enormous amount of wear and tear which has to be paid for by the companies on account of deficiencies in construction.

Passenger-Carriages.—In passenger-carriages the long springs somewhat modify the sensations experienced. But being very rigid and only slightly curved, they afford relief to a very limited extent. It is when these yield too much (on a rough bit of the line) that there is experienced the most disagreeable short bump occasioned by the carriage coming down on the flattened surface of the spring.

Third-class Carriages.—In the third-class carriages the motion is somewhat better than on the truck ; but the short, sharp jolts experienced are eminently unpleasant ; the sensations felt after a long journey rather resembling the soreness ensuing after a bruise. An eminent

surgeon, of large railway experience, informs us that he frequently hears third-class passengers complain for days from the constant knocking together of the knees which successive jolts during the journey produce ; for the close packing prevents any wide separation of the legs.

Second Class.—In the second class, where the seats are covered, the motion is broken up by this intervention into a greater number of less violent shocks, having less intervals between them ; for the total amount of motion communicated to the carriage is the same.

First Class.—In the first class this alteration in character of the motion experienced by passengers takes place to a still greater degree, on account of the thick cushions and padding. It becomes an almost incessant repetition of mere vibrations ; swaying the body according to the direction of the impulse.

The motion produced in railway travelling is of two kinds—vertical and lateral.

Lateral Movement.—The lateral oscillation is greater on the narrow than on the broad gauge lines. This may be readily understood on considering the wider base of sustentation on the broad gauge which necessarily diminishes the lateral range of swaying movement. It varies in different carriages in the same train, and according to many conditions. Its extent can scarcely be correctly estimated by personal sensations, as the beautifully elastic apparatus of the body supplies in some measure what the railway carriage is deficient in. But the shadow of an object cast by the flame of a railway lamp (or of one taken for the purpose), when the flame is steady, will demonstrate how continuous is this influence on passengers.

Vertical Movement.—The vertical movement is

only occasionally felt. It varies according to the weight of the carriages, and can take place to an extent of three inches and a half without lifting the wheel from the rail. The following represents the amount found to occur by examining carriages on different lines :—

Great Northern.—First class, $\frac{5}{8}$ to $\frac{3}{4}$ in.; second class, $\frac{1}{2}$ to $\frac{3}{4}$ in.; third class, $\frac{3}{4}$ to 1 inch.

South Eastern. — Average vertical movement (all classes), $\frac{3}{4}$ in.

Eastern Counties.—No difference in classes; average about $\frac{3}{4}$ inch.

Great Western. — No difference in classes; average vertical movement, 1 inch.*

The actual number of movements in a given time varies according to many circumstances. An eminent scientific chemist thus writes to us on this subject :—"I once counted 90,000 movements in a first-class carriage from Manchester to London, but how many more there were I did not further examine. There was a considerable variety in the kind of movement. I never attempted to count the number in a carriage without cushions."

Loose Coupling.—There is also another cause of movements of a most disagreeable kind to passengers, which is due to the carriages not being coupled sufficiently close together. Each of the coupling-hooks is fixed to a strong spring. The strain on this spring varies according to the number of carriages behind, which it has to pull onwards. The pressure on the buffer-springs is nearly uniform. Hence it happens that carriages which seem closely coupled when at rest are dragged apart as soon as a strain is put on the coupling-

* We are indebted for the opportunity of giving these measurements to the courtesy of the inspectors of rolling-stock of the various lines.

irons, and come together more or less forcibly when this strain is diminished. Thus a jolt takes place when the buffers come in contact, like that felt when fresh carriages are run up to be added to the train.

CHAPTER II.

EFFECTS OF RAILWAY TRAVELLING ON HEALTHY PERSONS.

VENTILATION AND TEMPERATURE.—The conditions of the air within railway carriages, according to its purity, its temperature, and the frequency of its renewal, must necessarily exercise considerable influence on the health and comfort of passengers. The following important observations on this subject have been communicated to us by Dr. R. Angus Smith, F.R.S. :—

"The air of several places being examined by the method described in my papers, I have found that a given amount of the permanganate solution is decomposed by different volumes of air, according to its state of purity. The numbers here given represent the volume of air capable of decomposing an amount of the solution of the permanganate, the same in every case. They represent, therefore, the proportionate purity of the air; the highest numbers represent the purest air.

Cubic inches of air requisite for the decomposition of a given amount of solution, showing comparative amounts of oxidizable matter.

MANCHESTER.

	Cubic In.
Air at All Saints', inside my laboratory	72,000
Front of the house	74,000 to 76,000
Bedroom looking to the back	64,000
Same room in the morning after being slept in ..	56,000

	Cubic In.
Bank of the Medlock, behind dirty houses ..	44,000
High grounds, thirty miles north of Manchester	176,000 to 209,000
Closely-packed railway carriage	8,000
When the strong smell of a sewer entered my laboratory	8,000

Thus a railway carriage closely packed stands very low in the scale. I may mention that the carriage examined was a third-class one. In very hot weather, the woollen coverings of a first-class carriage are hurtful, but I do not think them so in cool or in ordinary weather, if kept clean ; on the contrary, I think them beneficial. A good deal of the impurity is retained by the wool, and is not given off, but is oxidized in its place. A high temperature sends off some without oxidation, and produces what is called a choking sensation. When the sides are impervious to moisture, as in the second and third classes, there are great risings and fallings in the purity of the air. The impurity is then neither retained by the surface until oxidation takes place, nor slowly and gradually given out, but evaporates with great rapidity.

These remarks apply especially to cases in which warmth and cold, moisture and dryness, alternate. In constant warmth the impurity is not retained ; in constant cold it is not given out. When cold or moist it is retained, and given out again when dry or warm.

Similar remarks apply to carpeted and uncarpeted rooms. Carpets are incapable of causing any discomfort if perfectly clean, and even tend to purify the air ; but when not clean, they cause an unpleasant sensation, which increases with the temperature to a certain point. The more impurity there is the less will wool and

similar substances bear an elevation of temperature, unless the elevation be constant, when the wool seizes very little of the impure matter. With care and cleanliness, the linings of railway carriages may last pure till the cloth is worn out, and they do so in some places; but in some counties (and it seems to me that Lancashire is one of the worst) there is no regard to the property of the company or the comfort of those coming after; dirty boots are put on the cushions, and the carpets are fouled by expectoration. This is at first less felt in first-class carriages; but as it cannot on the present arrangements be conveniently washed out, it accumulates. This is probably the reason why our first-class carriages are made so much less comfortable than those on the Continent. It would be greatly to their advantage if they were disinfected occasionally. The most easy way would be to take out the cushion portion, raise it to the temperature of about 180° Fahr. or more, first with steam, then with dry air, and then beat and brush thoroughly.

The atmosphere of railway carriages is only apt to be hurtful from bad ventilation when crowded, because of the frequent opening of doors and the almost impossibility of keeping out the air. At the same time, it depends upon the state of the weather—the temperature of the wind chiefly. When temperature rises, all impure surfaces become more offensive and everything known has a smell—persons and animals pre-eminently. We can readily smell the inmates of a carriage for a considerable time after they have left, if the carriage has been crowded. But I know of no rule whatever as to the preservation of temperature or amount of air. The person who comes rapidly to the station wants fresh air;

and he who has been sitting for hours desires warm air. Nature tells each his requirement. The person weary with sitting and with his blood slowly circulating, does not require so much air ; if you give him as much as the person fresh and flushed, he cannot resist the lowering of the temperature, and becomes feverish, irritated, or chilled. Inferior air is better to him than loss of heat. And why ? The heat of the system must be maintained, no matter what else is diminished ; because every function depends on it. No wonder that persons, to avoid cold, breathe the impure air. Life may exist in pest-houses for years, and may continue through a raging fever for weeks ; but to be cooled down to a certain easily-reached point puts us in a few minutes beyond all help, and a draught may bring death like a bullet.

It would be a great point gained if carriages could be ventilated without a violent draught, laden with dust, in the face of some one who is supposed to be insensible to good air, because he is sensitive to cold ; he knows that he may very soon recover from the effects of any bad air generally caused by crowding in carriages, but from the cold he knows with no certainty when.

One of the evils of railway travelling in warm weather is the dust. The amount, especially at some distance from the engine, is sometimes more difficult to bear than the confinement of the air ; and I think it must at times be more hurtful than the work of the stonemason, beside whom I have frequently stood, feeling far less dust than on a railway on a fine summer day, and yet we know the mason suffers.

If the carriage is constantly ventilated moderately, no time is allowed for the wool to absorb the vapours from the breath and skin ; but if the carriage is some-

times filled with unpleasant exhalations for a considerable period, it may require a still longer time of the action of pure air to cause their removal and destruction. Mere change of air in the carriage is not sufficient. We may smell the air of a crowded building on persons who have left it many minutes—I can from experience mention twenty minutes, and I have no unusually acute sense of smell."

As bearing on and elucidating this part of our subject, we would quote the following most interesting communication from Dr. C. J. B. Williams, F.R.S. :—

The Chilling Influence of Railway Travelling. —Unquestionably the great charm and superiority of railway travelling is its *speed;* and in this fast age of rapid progress, when all the appliances of science and art are brought to bear on the problem of almost annihilating time and space, it would be an ungracious task to put a drag upon the wheels, provided that this charming velocity can be maintained without risk to health, and without danger to life or limbs. Of the perils from accidents incurred by high rates of speed I will say nothing, further than that they have their preventives in strict attention to accuracy of construction, excellence of materials, efficiency of working, and the most unremitting observance of regularity and punctuality, which it is the plain duty of managers and directors to enforce and maintain.

But the velocity of railway travelling may bring with it dangers of another kind—less appalling, indeed, than those from accidents, but of much more common occurrence, and not the less mischievous from the gradual and insidious manner in which they beset the

unwary traveller. I allude to the injurious influence of the draughts of air encountered in railway travelling.

The velocity of a railway train is such as to bring it in collision with the air to a degree that amounts to a high wind. Any one putting his head out of the window of a train in rapid motion may have some idea of the force of this current. This same current penetrates into the interior of the railway carriages more or less freely, according to the amount of openings in them. Through open windows it blows in full force; entering in front, it strikes the faces and fronts of those looking towards the engine, and whirls in rapid eddies around the polls and backs of those riding backwards. In the thirty or forty sultry days which may chance to occur during our summer months, this fine breeze may be all very pleasant; and if it do not bring dust with it, we would on no account exclude it. But in the remaining three hundred days and upwards this current is too cold to be borne in safety; and if not shut out by more or less completely closing the windows, as well as by the use of adequate clothing, it will surely and steadily chill the parts of the body exposed, and will as surely excite disease in those predisposed to it.

Of course these observations apply most strongly to the coldest weather of winter; but, be it remarked, the speed of the railway intensifies the cold, and renders the draught of air dangerous, even when its temperature may not be lower than 50° or even 60° Fahr. This result chiefly obtains in long journeys, especially during the night, when the drowsy traveller may hardly feel the cold till he wakes with cold feet and stiff limbs, and the depression and discomfort attending on a gradual and thorough chill. Express trains, which attain

the greatest speed, and make the fewest stoppages, are the most chilling, and therefore in long journeys are more dangerous than ordinary trains. Those railway lines which run far on high embankments or viaducts, or through a bleak open country, are the most trying in this respect, and the direction of the wind, whether against or with the train, has a considerable varying effect. An express night journey to Norwich, Hull, or York, in the teeth of a sharp north-easter, is about as *shramming* a trip as can be provided in this country. Yet the coldest journey by rail that I ever made was to Torquay on a night before Christmas of 1860. In spite of foot-warmers, abundance of furs, and closed windows and ventilators, all the glass of the windows was crisply frosted on the inside, and I was so benumbed with cold that I did not recover comfortable temperature for several days. It was the coldest night of that cold year, and on the next morning I saw the thermometer on a south aspect at Torquay standing at 12° Fahr.

The disorders which I have found to be most commonly excited by the influence of cold in railway travelling, are the various catarrhal affections of the respiratory organs, sore-throats, ear-ache, tooth-ache, pleurisy, pneumonia, and various forms of rheumatism, particularly lumbago and sciatica. It is very remarkable how many cases of serious pulmonary disease in my experience have dated their origin to cold caught in railway travelling.

Now, to prevent these evils, it seems a very simple expedient to close the windows as much as is consistent with due ventilation, and to use sufficiently warm clothing to exclude the cold; but the closure of the windows in a railway carriage is not so easy in practice as in

theory. The plurality of English folk love fresh air, and have a horror of closed windows; they prefer being chilled to their notion of being suffocated. And as it is the warm blooded and robust who commonly entertain these views, they often assume the management of the windows in accordance with them, to the great detriment of the delicate and susceptible. Foreigners on the Continent, even with their slower trains, commonly go to the opposite extreme. Even in summer they often persist in keeping the windows close shut, to the discomfort of their British fellow travellers; but I am confident that the graver error is on the side of our countrymen. Generally they are not aware of the risk to which they expose themselves and other passengers by keeping open windows in cold, or even cool weather. In fast trains, with the outer temperature below 40° Fahr., there is circulation of air through the ventilators and unavoidable chinks of the carriages, sufficient to keep the air pure, even with six or eight passengers, without any window open. When the outer temperature is above 40°, and the carriage full, an inch or two of one or both windows open may be permitted with safety. It is surprising how small an aperture suffices for free circulation of air when the train is in rapid motion. Exact experiments on this point are desirable; but as bearing on it, I would refer to the celerity with which, even in closed carriages, we smell the smoke of the break applied to the wheels at each stoppage; or the fumes of a tobacco smoker in an adjoining carriage, when he breaks the rules of the establishment and annoys his fellow-passengers by his own selfish gratification.

Finally, I would say on this topic, in cold weather and in fast trains there is vastly more risk of chill from open

windows than of suffocation or any other evil from closed ones. The ordinary ventilators will commonly prove sufficient when the train is in motion; as often as it stops, the windows may be opened with safety and comfort.

In the matter of clothing, people were slow to learn the exigencies of railway travelling. The railway rug has now become an institution; but several years elapsed before it was introduced, and even now its use is not so general as it should be, many are the sufferers from the want of it. The tendency of the general chill to affect first the feet and legs, and to throw the blood to the head and internal organs, is one of its most pernicious influences; and to prevent this the railway rug is invaluable. In winter weather the foot-warmers of hot water, or those heated by the waste steam, are further comfortable counter-agents of this chilling influence. When it is considered that in travelling by an express train a person passes through the air at least three times as quickly as in an ordinary carriage, it will not be too much to assume that he is exposed to at least double the chilling influence in cold weather, and will need at least double the amount of clothing that he would require in a stage-coach or post-chaise.

In conclusion, I would advert to the *desiccating* effect on the skin and mucous passages produced by long railway journeys, as another result of the operation of the current of air, which may be mitigated by the same means of exclusion and protection; but it is more completely removed by restoring the action of the skin by active exercises or by a warm bath.

PHYSIOLOGICAL INFLUENCE.

Habitual Travellers.—In considering the physiological influence of railway travelling upon public health, it is necessary to enlarge the sphere of observation beyond the mere act of travelling, and to regard some of the accessory conditions which surround it. Modern society has seized the occasion offered by increased facilities for business communication, and multiplied its means of pleasure and chances of recreation. Habitual railway travellers are found not only amongst those who move from place to place, urged by some necessary impulse; but also there is included amongst them a numerous class of season-ticket holders, who, from considerations of health, pleasure, or economy, locate their families at a distance, and daily travel by train to some great industrial centre; again seeking a country home in the evening. This most important class of travellers is especially subject to the extraneous influences alluded to. They are under the necessity of twice daily "catching the train;" and to a certain extent all their actions prior to departure in the morning and afternoon are influenced by the pervading sense of this anxiety. We will quote here a graphic communication of this matter from Dr. Forbes Winslow.

Dr. F. Winslow on Extraneous Sources of Anxiety and Fatigue. — I have, like many others, during the summer season, removed my family for a period to a watering-place some fifty miles from London, and travelled to and fro night and morning by express train. I have been convinced that the advantage of sleeping by the

sea-side, and of an occasional day of rest there, was fully counterbalanced by the fatigue and wear and tear of mind and body incidental to daily journeys over this considerable distance. I went to bed at night conscious that I must rise at a given and somewhat early hour, or miss my train. I am sure that this does not render sleep more sound and refreshing; and every one sleeps best on the Saturday night, when this disturbing element does not exist—since the next is the day of rest. In the same way breakfast is eaten with this necessity of being in time still on one's mind. Then, like every one else, I had to get the cab or carriage and go down to the station; to scramble for the morning paper and get a seat. Then comes the long journey, with all its fatiguing accompaniments. Finally, one has to get to one's residence; this process, or something like it, *mutatis mutandis*, being repeated twice a day. I refer to these separate details because it is in analyzing the general series of phenomena that I am able to explain the fatiguing effects, mental and physical, of constant railway travelling.

Concurrent Testimony of other Physicians.—The frequent ill-effects of this anxiety and mental pre-occupation are insisted on in the communications made to us by many physicians of great experience. They have a most important bearing in relation to certain diseases which will be elucidated in a subsequent section. Dr. Brown-Séquard observes, that the anxiety is so predominant in many otherwise healthy constitutions, that it produces often a practical incapacity for habitual travelling; and must evidently, when it falls short of this, frequently be injurious. When living near a railway-station, the frequent excitement, and constant hurry and

anxiety which he witnessed on the part of passengers arriving, impressed itself on his mind as a mischievous circumstance. In certain unhealthy conditions of the heart it has many times proved fatal.

But the actual fatigue and physical effects of the journey chiefly influence the mass; phlegmatic and robust-minded persons are little likely to allow themselves to be mentally agitated by the necessity for catching trains or the like. But let it here be noted, that a great number of the season-ticket travellers are men past the early vigour of life—time-worn by the continued cares of business during long residence in towns, and whom a more or less tardy success in the battle of life has enabled to afford for their families the salutary change of country or sea-side residence, or whom some warning of failing health compels to seek for themselves such a transformed version of the *rus in urbe*. This is a sort of constitution not able to bear unnecessary strain and fatigue.

We will next consider what are the conditions inducing functional change to which travellers are subjected in a railway train, proceeding at ordinary speed.

Effects on the Muscular System.—The immediate effect of being placed in a vehicle subjected to rapid, short vibrations and oscillations, as already detailed, is that a considerable number of muscles are called into action, and maintained in a condition of alternating contractile effort throughout the whole journey. The tendency of each movement is to produce more or less motion in the twenty-four pieces of which the spine is made up. These movements are counteracted, and the erect position of the body is maintained, by the adaptive contraction of that complex muscular system attached to

those osseous pieces. The more violent movements of the carriage call into action the various sets of muscles in the back and chest; and it is only by an incessantly varying play of muscular contraction and relaxation that the body is preserved in a tolerable state of equilibrium, and that the passenger combats with success the tendency to be shaken into a most unpleasing variety of shapes and positions. The head is especially thus effected, being naturally so balanced on the spine as to have a tendency to fall forward. The frequency, rapidity, and peculiar abruptness of the motion of the railway-carriage keep thus a constant strain on the muscles; and to this must be ascribed a part of that sense of bodily fatigue, almost amounting to soreness, which is felt after a long journey.

Influence on the Cerebral and Spinal Centres.—The hollow cavities of the spine and cranium, thus partially steadied by the muscles attached to them, contain the great nervous centres, to which concussion of any kind is so peculiarly hurtful that they are naturally cushioned on exquisitely-devised water-beds or are slung by fibrous ligaments, which have the effect of deadening the shocks of ordinary movements. It is unnecessary to dwell upon the injurious effects of commotion of the brain or spinal system of nerves. Cerebral or spinal concussions, in their higher degree, annihilate the functions of those organs. In the milder forms they lead up to disease which, remaining for a long time latent, may still ultimately end in paralysis.

The jolting of a railway carriage is a series of small and rapid concussions; and it is worthy to be noted that these increase in proportion to the rate of speed, and that most of the trains by which season-ticket holders travel

are express. It may, therefore, be judged, so far as anatomical grounds are concerned, in what manner the influence of reiterated concussions may be prejudicial.

The Seats of Carriages.—The well-padded and springy seats of first-class carriages do much to obviate the mischief of these concussions for those who can afford to travel by them: and it has been mentioned to us by a surgeon who, in a great manufacturing centre, is connected officially with several railway companies, that he has observed that men compelled to travel frequently by rail are fully sensible of the practical advantage thus offered by the padded or cushioned seats, and never, if they can avoid it, travel on any other. We believe that commercial travellers, as a rule, occupy first-class carriages, not as a luxury, but as a necessity of their nomadic life. But, however this may be, it is right to notice a remarkable fact in the relation of different classes of railway travellers. In 1849 the third-class passengers formed about 51 per cent. of the whole number; in 1860 they formed more than 57 per cent. It therefore becomes a matter of simple justice that the railway companies consider the health of this important class of travellers. In condemning them to sit on hard wooden benches, which transmit without mitigation the shocks incidental to the movement of the carriage, they submit them unnecessarily to one acknowledged source of evil influence on health.

The influence of railway travelling upon the brain cannot, however, be measured solely by estimating the character and extent of the concussions to which it is subjected. The brain is not only affected by the mind, but also through the avenues of the eye and ear, and

by the excitement of the respiratory and circulatory systems.

Of Mental Influences.—The mental condition of passengers by train is commonly, perhaps, sufficiently placid and unconcerned; but several eminently careful observers have, in their communications to us, alluded to an often experienced condition of uneasiness, scarcely amounting to actual fear, which pervades the generality of travellers by rail. The possibility of collision is constantly present to such persons. And every one knows how, if by chance a train stop at some unusual place, or if the pace be slackened, or the whistle sound its shrill alarm, a head is projected from nearly every window, and anxious eyes are on the look-out for signs of danger. So, too, the frequent lateness of trains, and the bad time which they keep, are causes of anxiety. The pace, also, prevents the traveller from that observation of natural objects and sights of interest on the road, which made coach travelling a source of mental relaxation and a pastime. The passenger is forced into subjective sources of mental activity; and where the tendency to excitement exists, this also, *quantum valeat,* must be esteemed an undesirable feature belonging to this manner of locomotion.

Effects on the Eye.—Objects on the road are passed with such velocity that they only produce momentary impressions on the retina; and thus the visual powers are severely tried. The rapidity with which the brain is necessitated to take cognizance of the retinal images taxes it also more or less heavily. The rapid impression of objects moving over the retina in railway travelling is productive of certain interesting physiological phenomena, to which we can only briefly allude. Sir David Brewster has touched upon some of them with the

ability for which he is distinguished. In a paper read at the last meeting of the British Association, this great physicist showed that "when we look at the lines which stones, gravel, or other objects form in consequence of the deviation of their impressions on the retina, and quickly transfer the same lines further back, where the velocity is less, the stones or gravel, or other objects, would for an instant be distinctly seen, just as we see distinctly rapidly revolving objects in the dark when they are illuminated by an electric flash or the light of an exploded copper cap." This phenomenon may be explained by a remarkable and interesting law of compensation. The rapidity and variety of the impressions necessarily fatigue both the eye and the brain. The constantly varying distance at which the objects are placed involves an incessant shifting of the adaptive apparatus by which they are focused upon the retina; and the mental effort by which the brain takes cognizance of them is scarcely less productive of cerebral wear because it is unconscious; for no fact in physiology is more clearly established than that excessive functional activity always implies destruction of material and organic change of substance. Dr. Budd, F.R.S., has directed our attention to the peculiarly dazzling effect of passing in rapid succession the white telegraph posts, from which the wires seem to fall and rise, appearing to the eye to undulate. When the traveller sets himself to read, he imposes yet further labour on the eye in tracing the shifting characters of his book or newspaper, and also on the brain. Especial notice is drawn to this point in an important communication which we received, and quote further on, from Mr. White Cooper, surgeon-oculist to the Queen.

Every one is conscious of the strain upon eyesight incidental to railway travelling and to reading in the train; but it is probable that few habitual travellers are sufficiently cautious in this matter, and that many only become wise by too tardy an interpretation of their personal experience.

Impressions through the Ear.—The rattle and noise which accompany the progress of the train create an incessant vibration on the tympanum, and thus influence the brain through the nerve of hearing. Noise is conveyed by vibrations of the air; and hearing is the transmission to the brain, through the medium of the auditory nerve, of those measured vibrations which constitute special sounds. The habitual traveller is little mindful of it, and the brain of many persons is perfectly tolerant of the excitement. But this is an important item in the general cerebral impressions produced. Dr. Fuller, of St. George's Hospital, in communicating his personal experience of the influence of habitual railway travelling, mentions a device adopted by him which furnishes at once a test and remedy for this source of cerebral excitement. Surmising that some part of the headache and mental fatigue experienced was due to the rattle and noise, he filled each ear with a light plug of cotton-wool. In this way the vibrations of the air in the meatus were arrested, and the relief is described as having been considerable.

Assailed through the avenues of the eye and ear, and subject to concussions due to vertical movement and lateral oscillation communicated through the trunk, and actually transmitted by the bony walls of the head when it rests against the back of the carriage, the brain is apt

to suffer certain physiological changes. Amongst the well-known effects are—occasional dizziness, headache, sickness, and mental fatigue.

Combined Effects on the Brain.—To these results each of the above causes may contribute something. The noise may be considered most influential in producing head-ache; but this may be aided by the impression of rapidly-passing objects on the eye, or by the effort of reading. For nothing tends more certainly to produce congestion of the base of the brain than the forced fixation of the eyes upon a near object. This is evidenced by experiment, and explained by the connexion of the circulation of the eye with that of the brain, through the ophthalmic artery, springing from the circle of Willis. Some powerful illustrations of this fact are afforded in the phenomena of hypnotism and electro-biology, and of some of the so-called mesmeric phenomena, where sleep and the required changes of the cerebral circulation are physically produced by fixing the eye upon an adjacent shining body. The mere aspect of a swinging object sometimes suffices to produce sickness, as in the late celebrated Dr. James Johnson; and thus rapidly-passing objects may aid in the frequent production of nausea in the train. Probably the concussion incidental to the movement of the train is more potential in bringing about this effect. The influences on the respiration and circulation will hereafter be mentioned.

Any sudden alteration of the heart's action may aid in producing giddiness and dizziness, which are not always felt during the journey so strongly as after leaving the carriage. And it is when the circulation is returning to a more regular standard that a temporary access of sick-

ness and vertigo is often experienced. These symptoms have been especially noticed in the case of the travelling Post-office officials, as to whom Dr. Waller Lewis, the medical superintendent of the Post-office, has communicated to us a most valuable mass of information.

Nausea and Faintness. — The tendency to nausea sometimes felt by railway travellers, without any apparent complication of cerebral disturbance, is often due to jolting of the intestines and gall-bladder, stimulating the latter to discharge its contents into the stomach, and thus excite biliary sickness. Many cases have been communicated to us of sickness induced by railway travelling, and some persons are unable to undertake a journey without providing against this unpleasant affection. Bilious subjects Dr. Waller Lewis considers, from his experience, to be unfit for the travelling service, and he rejects such candidates for that employment.

The Nervous Influence.—In the valuable communications on the subject of this inquiry made to us by Dr. Brown-Séquard, the probable cause of sickness is explained by reference to the influence of the movements in a railway carriage on the phrenic, splanchnic, and vagus nerves. It is known by the experiments of several physiologists, that irritation of the vagus nerve produces vomiting; and the jolting of the stomach, separating it from the diaphragm and producing corresponding traction of the œsophagus (which is attached to the diaphragm, when passing through that muscular septum), is admitted by physiologists to afford the best explanation of the ordinary phenomena of sea-sickness. A second cause of vomiting, as shown by the experiments of Luschka, is the irritation of the phrenic nerves due to the shaking

of the diaphragm. Dr. Brown-Séquard, in former publications, has already investigated this subject experimentally, and has not only given confirmation to these observations, but has carried them further; and the results of his experiments will serve to give the physiological explanation of the peculiar *faintness* always accompanying nausea arising from the movements of a ship or railway carriage. He has shown that irritation of the sympathetic nerve in the abdomen induces cardiac syncope by a reflex action, influencing the action of the heart through the impressions conveyed by the splanchnic nerves acting upon the vagus through the spinal cord and medulla oblongata. The reflex character of the phenomena can be demonstrated by dividing the vagus in animals, when the irritation of the sympathetic no longer produces this cessation of the heart's beat, or by the division of the spinal cord between the communication of the sympathetic and the origin of the vagus, when a similarly negative effect is produced. Thus the faintness which sometimes occurs to travellers in a railway carriage, and the sickness accompanied by faintness, equally find their true scientific explanation. Every one has observed the marble pallor which accompanies this nausea: it is simply the result of a true fainting of the heart always preceding this form of sickness. It is needless to insist upon the important application of this physiological fact to all those persons who, being the subjects of fatty degeneration or other disease of the heart, are most likely to suffer from this kind of syncope, and in whom the organ may less readily recover from the temporary paralysis. There are two remedies of great value in diminishing these evil effects. A thoroughly tight bandage around the abdomen; inasmuch as it pre-

vents, to some extent, the shaking of the stomach, and consequent irritation of the vagus nerve, so precluding the occurrence of sickness; and chloroform taken into the stomach may similarly prevent or diminish the annoyance by partially paralyizng the vagus.

Respiration.—Railway travelling, like all rapid movement through the air, tends to increase the amount of air inspired, whilst the rate of respiration may remain unaltered or even be diminished. Hence it is that asthmatical persons often experience remarkable relief when travelling by rail; whilst the irregularity and rapidity of the currents of air in the carriages injuriously affect those susceptible to catarrhs and bronchitis. To the same causes may be ascribed that troublesome laryngeal irritation which frequently affects susceptible persons on attempting to converse in a railway carriage going at a high rate of speed.

In order to fairly estimate the influences produced by railway travelling, it is necessary to bear in mind numerous modifying circumstances which more or less affect the respiration,—such as temperature, food or stimulants recently taken, previous hurry or anxiety, &c. The following are the results of seventy-three careful observations made by Dr. Edward Smith on a healthy person, and where the effects of these extraneous influences were carefully guarded against. The results we here quote fail to convey any idea of the elaborate and laborious experiments on which the conclusions are based. Of the seventy-three experiments, part were made when travelling on the engine and part in railway carriages of each class. They were chiefly conducted on the Great Western Railway.

Cubic Inches of Air respired during Railway Travelling.

	Cubic in. per minute.
On an engine in motion	615 — 840
In a first-class carriage	545 — 691
In a second-class carriage	656 — 714
In a third-class carriage	700 — 712

The average amount of cubic inches respired by the same person varied from 450 cubic inches when in the horizontal posture, to 500 cubic inches when standing.

The variations according to speed were found to be as follows :—

	Respired air. Cubic in. per minute.
20 to 30 miles per hour	685
30 to 40 „ „	738
40 to 50 „ „	729
50 to 60 „ „	705

The effect of stopping the train was to produce a remarkable diminution in the amount of air respired—from 733 cubic inches to 528 cubic inches. The influence of greater oscillation was also perceptible on the respiration, the amount being increased from 681 to 731 cubic inches.

The rate of respiration varied from 13·4 to 16·5, with an average of 14·5 per minute. On an engine the average was 14·4 ; in the first-class 14·2.

The comparative relation of the amount of respiration under different conditions would be as follows, the horizontal position being taken as the standard :—

Quiet lying posture	1
Sitting	1·18
Standing	1·33
Railway, first-class	1·40
„ second-class	1·50

Railway (on Engine).

20 to 30 miles per hour	1·52
30 to 40 „ „	1·64
40 to 50 „ „	1·61
50 to 60 „ „	1·58

CIRCULATION.

The influence produced by railway travelling on the circulation of a healthy person, care being taken to avoid all circumstances tending to alter the ordinary condition of the heart's action, is certainly not more than that produced by other kinds of travelling. But when the passenger does not possess this state of physical health and freedom from emotional influence, railway travelling will, *cæteris paribus*, tend to produce a greater effect than is occasioned by any other mode of conveyance.

Effect of Alarm.—The frequent tunnels on one of the railways has been mentioned to us as an objection to travelling on it by persons in tolerable health, but with a commonly-shared dread of tunnels; the direct physical effect noticed by them being a sudden increase of the heart's action. This effect is secondary, for it is through the nervous system that the influence is produced. But it demands notice on account of the organic mischief which is known to result from excessive functional disturbance of the heart's action often repeated. A person of this impressionable kind (not necessarily weak or otherwise unhealthy) undergoes a succession of such small alarms throughout every journey, and often from very slight causes—the sound of a whistle, the passage of another train, passing a junction, excessive motion in the carriage, &c.; and this repeated day after day, especially

when business is transacted in the interim between the morning and the evening journeys, may become actually injurious. In several cases this recurring palpitation, increasing in frequency and severity, has been alleged as the reason why season-ticket holders have given up daily travelling before the expiration of their tickets.

Summary of Physiological Influences. — The fatigue, then, which follows upon prolonged and oft-repeated railway journeys may be considered a complex result of several influences, variously affecting the different organs of the body. It is made up of the effects of the muscular efforts to retain and restore the equilibrium of the spinal column and to keep the head balanced; of the impressions on the brain produced by the rattle affecting it through the nerves of hearing, the rapid succession of objects presented to the sight, and the vibrations actually transmitted by the movement of the carriage to the very substance of the brain and spinal cord. Let us add to this the effects of hurry and anxiety to catch trains, and the frequent concentration of mental effort required to compress business matters at the last moment into the strict limits thus imposed, and we shall find a concurrence of circumstances the tendency of which would necessarily be to produce considerable wear and tear both mental and physical. The physiological considerations on which we have briefly entered are certainly sufficient to lead to this conclusion; and the large number of instances in which season-ticket holders have been compelled to desist from the practice of long daily journeys may be thus fully explained. There is strong evidence, indeed, in favour of the opinion that the privilege of country residence may be dearly bought at the cost of long daily journeys by rail.

RAPID AGEING OF SEASON-TICKET HOLDERS.—A striking observation on this point has been communicated to us by one of the leading physicians of the metropolis. "Travelling a few years since," he says, "on the Brighton line very frequently, I became familiar with the faces of a number of the regular passengers on that line. Recently I had again occasion to travel several times on the same line. I have had a large experience in the changes which the ordinary course of time makes on men busy in the world, and I know well how to allow for their gradual deterioration by age and care; but I have never seen any set of men so rapidly aged as these seem to me to have been in the course of those few years. This was an independent observation made without reference to any investigation then or at any future time to be carried on. The change was so rapid that it forcibly arrested my attention, and I must say that it gave me a strong impression adverse to the practice of such habitually long journeys. It is idle to say that journeys from one end of London to the other occupy as long or a longer period of time; for, as you well know, and no doubt have carefully made out, the hurry, anxiety, rapid movement, noise, and other physical disadvantages of railway travelling, are peculiar to that method of conveyance, and a railway journey of an hour, at the rate of fifty miles an hour, is almost as fatiguing as half a day's journey on the road."

In this able expression of the experience of a long life, full of opportunities of wide professional observation, there are embodied the general conclusions of a great number of physicians, from the collation of whose opinions we are forced to conclude that their individual experience has led them to similar results. It

accords, too, with the views current in all classes of society.

Diminution in Number of Season-ticket Holders. —It is to the impression thus produced by this experience and the inconvenience so endured that we may probably refer the remarkable falling-off in the number of season-tickets issued to the public, as shown by the Government returns. The number of season-ticket holders in England and Wales in 1859 was 35,322; in 1860 it had fallen to 30,500. Here is a diminution of nearly 5,000 in the year.

Question of Life Assurance.—Those best able to decide this question, by their wide experience and knowledge of the habits and constitutions of men of the world, appear almost unanimous in this view of the subject. Even the eminent surgeons who have expressed themselves least strongly to us as to the effect of habitual railway travelling on healthy constitutions, find their experience led up to this view. Thus, Mr. Partridge, surgeon to King's College Hospital, states, in modification of his otherwise generally favourable experience in this matter, the following as amongst the instances with which he has met of disordered function due to this cause: "1, temporary paralysis from an over-distended bladder; 2, headaches; 3, giddiness; 4, temporary dizziness of vision; 5, inability or, rather, inaptitude for mental work usually." Finally, a physician, who has studied the subject of the duration of life in relation to insurance, states that he makes a rule of inquiring of intending assurers whether they are in the habit of taking such long journeys; not with an eye to the probabilities of accident, but in the conviction that the health is likely in the end to be impaired by them, and

any tendency to disease to be fostered and exaggerated. An eminent actuary informs us that the attention of the actuaries of the various societies has been more than once directed to the subject.

CHAPTER III.

HEALTH OF RAILWAY OFFICIALS.

IF now we seek for further accurate information as to the practical influence of railway travelling upon the health of those constantly on the rail, it is obvious that certain results may be looked for in relation to travelling *employés* of the railway companies, and of the General Post-office, which may throw light upon this subject as it affects the general public.

LITERATURE OF THE SUBJECT. — In this inquiry it might be expected that we should find a wide collection of facts, and be enabled to avail ourselves of the previous labours of others. The question is, however, one as to which our literature is almost barren, and the reliable documents on the subject are few indeed. We find that in England no literary materials are at hand for the purpose. We have to rely upon our extended personal inquiries amongst the Provident and Friendly Societies of the Railway Companies, and the kindness of surgeons who have had experience in attending their members. In addition, we have found information in the "Report on Friendly Societies," by Mr. Finlaison, and the valuable "Contributions to Vital Statistics," by Mr. Neison (London, 1857). In France, an active discussion has been carried on as to the health of railway servants. Monographs of interest

have been published by Drs. Pietra Santa,* Devilliers,† and Duchesne; and papers have been read by Drs. Martinet, Bisson, and Cahen, at the Academy of Sciences. A species of controversy has, indeed, arisen, the official medical advisers of the companies throwing a doubt on the observations of other physicians who have described in strong terms the deterioration of the health of railway servants.

Health of French Railway Servants. — Dr. Devilliers, as chief physician of the Lyons and Paris Railway, availed himself of the wide field of observation open to him to analyze very minutely the diseases of the servants of the company; and, although he appears as the professed apologist of the company, his conclusions are important. Dr. Devilliers found that one-fifteenth of the drivers and firemen were suffering from affections of the brain and nervous system. The greater part of these diseases consisted of cephalalgia and neuralgic pains; amongst the latter are ranked facial and sciatic neuralgia. The most remarkable affections which he enumerates are cerebral concussion, meningitis compelling the relinquishment of labour, and eleven cases of cerebral congestion amongst 352 individuals. Diseases of the joints and muscles affected about one-fourth of the whole number of the firemen and drivers, and consisted chiefly of lumbago, spinal affections, and muscular and articular pains. Amongst

* Pietra Santa: Chemins de Fer et Santé Publique. Paris: Hachette. 1861.

† Recherches Statistiques et Scientifiques sur les Maladies des Diverses Professions du Chemin de Fer de Lyon. Par le Dr. C. Devilliers, Médecin en Chef du Chemin de Fer de Lyon. Paris: Labé. 1857.

the guards, breaksmen, and travelling inspectors, who are subject to the influence of active motion in the train, affections of the brain and nervous system are also described as "relatively numerous." Amongst them occur again cerebral concussion, cerebral congestions, inflammations of the brain, and a certain number of sciatic, facial, and other forms of nuralgiæ. Other independent observers in France have described, in language of a much more positive kind, certain affections resulting from railway travelling which they have found to exist amongst guards.

Dr. Martinet on an Affection of the Spinal Cord. —M. H. de Martinet described, in 1857,* an affection experienced by travelling railway officials and engine-drivers in the following words :—"The nervous system is injured; the persons affected grow thin; the generative power dies out; the body is agitated by starting and convulsions; the intelligence is weakened. Cold affusions on the spine seem to me, in respect to treatment, to be the principal means which should be employed." Dr. Martinet was so impressed with the character of these symptoms that he described them as constituting a new disease. This paper was confirmatory, and in effect added something to the statements of Dr. Duchesne, who announced to the Academy, as the result of his investigations into the health of the railway travelling *employés*, that their health suffers from this employment in a degree proportionate to the duration of their service. "This evil influence," he says, "is shown by a notable loss of visual power; the loss of hearing; rheumatic affections, principally on the right

* Académie de Sciences, Séance du 23 Février.

side of the body ; and, finally, by dull, continuous, persistent pains, accompanied by a remarkable sensation of feebleness and numbness, rendering the acts of walking and standing equally painful." It is worthy of note that these pains and symptoms of disordered innervation are especially seated in the lower limbs, and equally on the right and left sides. From the general review of evidence, however, it may be concluded that, owing to wise precautions and moderate hours of work, French railway servants suffer much less than English.

Number of English Employés.—On the railways in this kingdom there are upwards of twenty different occupations, each a business in itself. These employ more than 100,000 individuals ; and if we take the collateral employments, the opinion expressed by Mr. Stephenson, that two per cent. of the whole population derive their maintenance from railways, would appear to be rather understated.

Amount of Sickness.—There is great difficulty in obtaining any reliable results from the records of the health of travelling railway officials in this country, owing to an absence of centralization, and want of uniformity in sickness and death returns. Amongst the superior officers of the companies and some of the surgeons connected with them, an impression prevails that the railway *employés* may be regarded as a healthy body. Individual notions, of course, vary greatly on this point, and we are met by contradictory opinions and series of facts. It is only by an accurate summary of large masses of facts that trustworthy conclusions can be obtained. Perhaps the largest collection of figures to which we can refer may be culled from the analytical tables of Mr. Finlaison. These figures certainly justify

the observation of that distinguished actuary, that "the liability to sickness amongst the persons employed on railways is unusually great." The extent of this liability the following tabular analysis will show :—

Number of Sick Persons out of each 100 *liable to Sickness.*

Age.	England and Wales.	Ordinary Heavy Labour.		Mariners.	Miners.	Railway Officials.
		Without Exposure.	With Exposure.			
20	26·62	26·47	28·69	16·89	23·23	31
25	23·94	25·10	26·47	15·61	20·90	33·06
30	22·57	23·45	25·74	17·96	28·65	33·94
35	22·38	24·00	25·64	18·86	32·50	34·11
40	23·26	24·34	27·01	17·89	28·92	32·23
45	24·11	25·14	28·14	20·51	37·56	32·10
50	26·00	28·10	29·34	22·27	36·87	30·43
60	31·07	33·25	35·42	28·00	58·62	41·76

Perhaps this may be understood more clearly by a table in which the average amount of sickness per annum to each person is stated in days, and the relative healthiness of mariners and the general working population compared with that of railway officials :—

Average Amount of Sickness per Annum to each Person, in Days.

Age.	England and Wales.	Heavy Labour.		Mariners.	Railway Officials.
		Without Exposure.	With Exposure.		
20	6·88	6·71	7·16	5·24	8·00
25	6·83	6·82	7·45	5·21	8·63
30	6·91	7·06	7·69	6·59	9·93
35	7·14	7·45	8·04	9·02	8·89
40	8·21	8·03	9·40	7·99	10·91
45	9·34	9·87	10·78	11·41	12·15
50	11·49	12·15	12·58	13·41	15·23
60	18·73	20·36	21·78	24·55	15·45

Thus it will be seen that there is a greater number of sick persons and a larger average amount of sickness amongst railway servants than amongst either of the classes compared with them. The excess over that of the average population of England and Wales is very considerable indeed, and runs through all the ages under 60.

These figures include all classes of railway servants. In excluding all but travelling servants we are compelled to resort to individual experiences; but we find no reason to believe that the figures would present a more favourable aspect if confined to the latter class.

Picked Lives.—The result of inquiries carried on amongst the travelling servants of all the great companies has been to convince us that only picked individuals are fitted for the service; and that it is amongst these picked lives that the above high rates of sickness prevail. To be able to endure the fatigue of the travelling service, a man must not only be of perfectly sound and healthy constitution, but he must begin *young*. It was stated to us on all hands that men over thirty or thirty-five find themselves unable to acquire a tolerance of the bodily and cerebral fatigue involved in the duties; and that, after considerable experience on this head, the companies have found it necessary to limit their engagements to young and healthy men. The effects produced on men who commence railway work in middle life, as described by the officials themselves, confirm an observation already quoted. They age rapidly. "They can't stand it, lose their heads, and become old men in no time," to quote the graphic words of an experienced engine-driver. This may be considered to some extent a crucial test. In the absence of

figures and exact results, we avoid drawing conclusions from the isolated cases of illness communicated to us as having been occasioned amongst travelling servants by the peculiar influence of their locomotive habits, reserving these cases for subsequent analysis.

THE HEALTH OF TRAVELLING POST-OFFICE OFFICIALS.

THE following able and interesting report on this subject has been communicated to us by Dr. Waller Lewis, principal Medical Officer of Her Majesty's Post Office, whose indefatigable exertions on behalf of those under his charge are already so well known to the profession :—

In the summer and autumn of 1859, I was requested by the Postmaster-General to investigate the effects of railway travelling on the health and strength of the various officers employed in the railway post-offices. For this purpose, accompanied by one or more of the chiefs of the Mail-office, I made the journeys, both day and night, on the principal routes in England, Scotland, and Wales. I observed the officers in the performance of their several duties, and inquired minutely into the state of their health before they joined the railway department, as well as into their then condition. In addition, I made, of course, my own observations on their appearance, &c., and I have, since that time, had constant opportunities of seeing and examining many of them. I made copious notes at the time, and have since added largely to these at each occasion of my seeing the officers. I examined them as to the early effects of

travelling upon them, as well as upon any they may have experienced after they had become accustomed to the work. I also made inquiries amongst those who had been in collisions and other accidents as to the immediate as well as the secondary effects, if any, that resulted.

In addition to the special inquiries above alluded to as having taken place in 1859, I have been in the daily habit, during four or five years previously, and from that time to the present, of examining and prescribing for a great number of these officers. They comprise not only those who have been labouring under ordinary illness, but also nearly all that have been injured by accidents, of which there have been, unhappily, a considerable number during the last three years.

The total number of persons employed in the travelling department of the Mail-office, when complete, is above 300, who are thus classed :—

Inspectors of mails	.. ..	5
Clerks	.. ..	47
Sorters	.. ..	137
Mail guards ..	.. .. .. about	80
Acting mail guards	.. .. .. ,,	30
Messengers, &c. ..	.. .. .. ,,	10
		309

The clerks and sorters are occupied during the journey in sorting the letters and making various entries in writing connected with this duty. While at work the greater number of them stand, although seats are provided for their use ; but it appears that most of them prefer the erect posture, keeping at the same time the right hip in contact with the ledge of the sorting-table. They state that they are able to keep themselves more

steady in this position than in any other. It is curious to notice a peculiar motion that all, or nearly all, these officers gradually, and I believe unconsciously to themselves, contract while engaged in the discharge of their duties. I allude to a movement of the body of a slightly swinging character, not directly backwards and forwards, nor lateral, but a compound between these, resulting in a diagonal. I imagine it must have some effect in neutralizing the jerking character of the train motion, and probably resembles in that respect the peculiar movement of sailors when at sea—the "sea-legs," as they phrase it.

The average length of the journeys of the clerks and sorters is about 170 miles; the average amount of time occupied in the journey about five hours and a half. The highest speed attained on any of the mail routes is between London and Dover. This journey is done at the rate of forty-four miles an hour, *stoppages included.* I do not know the *average* speed at which mail trains travel. The distance that mails are carried by railways is now above 30,000 miles daily.

The mail guards are employed in sorting newspapers and putting them in the bags; in tying, sealing, and arranging the bags when made up, and in working the mail-bag apparatus as the train flies by the different second and third class stations at which he does not stop. These duties require the possession of considerable muscular power by these officers, and consequently larger and stronger individuals are best fitted to discharge them. On night mails, the travelling clerks and sorters, when their regular work is not interrupted by emergencies, have about two days' rest in eight, while the guards have about two in six. On day mails a smaller

proportion of rest is found sufficient. The Lords of the Treasury have also authorized a floating force to provide for the absence of officers on leave, or on account of protracted illness.

Persons best fitted for Railway Travelling.—From much observation amongst those now at work in the travelling post-offices, as well as from inquiries amongst those who have been obliged to give up these duties, and from information acquired from other sources, I am convinced that, *cæteris paribus*, tall persons are most influenced by this kind of locomotion. I conceive that it is so easy to account for this fact, that I need not here give the reasons for it. A person of full habit of body, with a bounding pulse, is much less fit for travelling duties than a more wiry individual, with little superfluous fat. I should be inclined to reject all candidates for travelling clerks and sorters who exceed 5 ft. 9 in. in height, or who weigh less than $8\frac{1}{2}$ stone, or more than $10\frac{1}{2}$. I find, generally speaking, that officers who commence those duties at an age exceeding twenty-five are less able to endure them continuously than those who have begun them earlier. All candidates applying for travelling appointments are subjected, as part of their examination, to the test of the dynamometer, and I usually reject those who cannot exert a pulling power of at least 250 lb. One of our mail guards, when in health, lifted easily 650 lb. ; but a few weeks after receiving a severe concussion in a collision on the railway, it was with great difficulty he could raise 450 lb., although he was then convalescent.

Effects of different Gauges.—I am convinced, from the most careful and repeated inquiries into this point, as well as from personal experience, that the

narrow-gauge lines exert a greater influence on such persons as are liable to be affected by railway travelling than those constructed on the broad-gauge principle. The greater, also, the speed, the more injurious are the effects on persons so liable. There is more vibration and more oscillation at a high speed than when the train is moving more slowly. While personally carrying on the investigation above alluded to, I have sometimes been so shaken as to have experienced considerable difficulty in preventing the act of vomiting. The oscillation has at times been so great that I have been quite unable to stand steadily without holding on by some fixed body. The oscillatory motion is most strongly experienced when going rapidly over sharp curves on the narrow-gauge lines. It occasionally gives rise, in persons unaccustomed to the movement, to temporary giddiness and sickness, and has a tendency, after some time, to disorder the functions of the liver and stomach. Indeed, the effects are very similar to those experienced by many persons when on the sea in a steamboat, but in a minor degree. The liability to be so affected is much increased if the journey is taken with a full stomach, more particularly, as is not unfrequently the case with passengers by railway, if the meal has been hurriedly swallowed.

Influence on Healthy Persons.—Railway travelling, as might be anticipated, is found by experience to affect different individuals very variously. On those persons who have good constitutions, are free from tendency to hereditary or other disease, and are physically well adapted to bear fatigue, this method of locomotion, even when persevered in for many years, appears to have but slight, if any, injurious effects. Some of our officers in this department have been in the daily, or

rather nightly, habit of railway travelling for periods varying from ten to eighteen years, without their health or strength apparently suffering in any degree. Some had travelled every night consecutively for three or four months together. One had been on the railway every night during a period of six months, not omitting Sundays. I could not discover that he had suffered from this long-continued and severe labour, although he complained of being weaker than he was before. Another had travelled sixty-four miles every night, with two exceptions, for the long space of ten months, and made no complaint of the state of his health. I must add that the authorities of the department did not know of these cases of continuous duty, and that in some of them this unusual amount of travelling arose from the desire of the officers to increase their emoluments. Such facts, having once come to my knowledge, and having been reported to the Postmaster-General, will, as far as possible, be guarded against hereafter. Indeed, the plan now about to come into operation ensures, under ordinary circumstances, due rest to every clerk, sorter, and guard, in the department.

Not only does railway travelling seem to have no injurious effects on some persons, but I have much evidence tending, apparently, to show that it is sometimes absolutely beneficial.

It has been part of my duty to examine very recently some sixty or seventy of the travelling sorters, for the express purpose of reporting as to their physical fitness for railway duties after they had undergone a probation varying from six to eighteen months. Several, however, of the officers so examined had been acting as mail guards for a much longer period. In reply to my

question of how they found the travelling agree with them, some stated that they had never been so well in their lives. A considerable number replied that they had not had an hour's illness since they had commenced railway duty.

Another effect of railway travelling on certain constitutions is curious, because it is just the reverse of what might have been expected. Young men, previously extremely thin, are found rapidly to gain flesh, and to become as fat as they were before lean. These instances are by no means so rare as to be deemed mere exceptions. The converse also holds true. One of our best officers states that he has no doubt that during the period of twenty years that he was engaged in railway duties, he travelled, on an average, a hundred miles a day, Sundays included. All this time he not only enjoyed most excellent health, but he was stouter and stronger than he has been since leaving that duty.

It is very probable that these facts may partly be accounted for by the large amount of time spent in the open air of the country, and partly by the stationary character of the employment.

Experience, however, shows that even perfectly healthy and strong persons are affected by railway travelling if their habits become irregular, and if they do not take a due amount of rest.

Influence on the Unhealthy.—While, as I have said, the great majority of *well-selected* individuals can undergo railway travelling for many years consecutively with impunity, others, who are more weakly and delicate, or whose physical conformation is not adapted for receiving a constant succession of slight concussions,—the effect of railway locomotion,—suffer more or less

severely. The ill effects experienced by such persons depend, of course, upon the peculiarities of their constitutions and the nature of their diseases. In persons inclined to be bilious, sickness, or at any rate nausea, giddiness, and loss of appetite, are the constant effects. Usually these symptoms do not come on until the termination of the journey. This is probably due to the different conditions of the circulation in the brain while travelling and when at rest.

At other times sickness is present during the journey. One of our clerks was obliged to resign from this cause. His sickness did not appear to diminish by time. I have known some persons who cannot ride, even in a first-class carriage, without nausea and slight faintness.

Tall, thin, weakly-made persons complain of pain and stiffness, sometimes amounting to cramp, in the knees, legs, and spine. This is particularly the case with those who stand during the journey. I have found these effects much diminished by supplying for the use of our officers elastic caoutchouc mats, which intercept nearly all the vibration. A marked difference is experienced when one foot is placed on the bare floor of the carriage, while the other rests on the elastic mat.

In consequence of the extreme difficulty—hitherto amounting to an impossibility—of duly regulating the ventilation and temperature of the carriages in motion, all diseases of the lungs and air-passages are much increased in severity and quickened in their progress by the dust, draughts, and extremes of temperature incidental to railway travelling. In summer these vehicles are sometimes insupportably hot, especially, as is often the case, when they have been exposed to the direct rays of the sun before the train is made up. In winter,

on the other hand, they are often intensely cold, especially during a severe frost. No attempt is made to diminish this inconvenience, further than by supplying hot-water tins to some of the first-class passengers.

I have found that carriages built with a double roof have the effect of moderating the excessive heat in summer and the severe cold in winter. The manager of the Bristol and Exeter Railway Company placed at my disposal a carriage so constructed, during some official journeys I made two or three years ago. I was much pleased with the increased comfort caused by the false roof, as, in addition to the improvement of the temperature, it appeared to lessen in some degree the great noise produced by the motion of the train, particularly while passing through tunnels.

Previous to my connection with the Post-office, some officers suffering from phthisis in its first or second stage had been appointed to the travelling department. In every instance that has come to my knowledge this duty hastened the fatal development of the disease, sometimes to the conviction of the sufferer himself.

Disease of the heart, its valves, or its great vessels, wholly incapacitates for railway locomotion.

I do not, however, find that patients suffering from simple rheumatism are the worse for doing clerical or sorting duties in the railway post-office. Probably the protection from wet accounts for this fact.

One officer, of a highly nervous temperament, was very properly recommended by his medical attendant to resign his travelling appointment, on account of unmistakable premonitory symptoms of paralysis. Invariably after each journey frequent starting and involuntary movements of the limbs came on. In walking,

he planted his feet vaguely and uncertainly. When he wished to take a paper or other object in his hand, he could not do this deliberately and quietly, but felt himself compelled to snatch at it, and then sometimes missed it. His sleep was much broken, and afforded him but slight refreshment. While sleeping, he constantly felt the jolting of the train. He states that he lost so much flesh that he was reduced to a skeleton. He was obliged to give up the travelling after a trial of three or four months. He was then twenty-six years of age. Several years have passed since he left those duties, and, although he finds it necessary to be very careful in his habits and diet, he has had no threatenings of paralysis from that time.

Two other officers were forced to resign from the occurrence of actual paralysis. As I did not know these gentlemen personally, I am unable to give any opinion as to how much of the disease was to be attributed to the travelling, and how much, if any, to predisposition, or other causes. One of them died subsequently of disease of the brain, the other is pensioned, and is still living.

Reading in Carriages in Motion.—From my own experience I do not find that much mischief is occasioned *to the sight* from the practice of reading or sorting letters in a moving carriage. If the latter practice be at all injurious to the clerks and sorters, it must arise, I believe, from their working by strong artificial light. But there is no difference in regard to this while discharging similar duties in a stationary office. There is, however, one practice or habit, connected with this subject, indulged in by some railway travellers, especially non-habitual passengers, which is certainly injurious, and

should be avoided. I allude to that of allowing the eyes to rest on external objects *near at hand*, such as the telegraph posts and wires, near trees, hedges, &c. This produces a mischievous effect on the eyes, and secondarily on the brain. There is comparatively little harm in looking at distant objects, which do not apparently flash before the eyes with the lightning-like rapidity of things that are near to the carriage. Every one must have observed the effect of this practice on himself. It causes almost a temporary blindness, followed sometimes by giddiness.

ACCIDENTS, AND THEIR PRIMARY AND SECONDARY EFFECTS.—During the time that I have held the appointment of medical officer to this department, there have been several collisions and accidents of other kinds in which mail trains have been involved. Although a considerable number of our men have been more or less hurt by being thrown upon the floor of the carriage in which they have been engaged, I am glad to say that these accidents have been attended in but one instance with a fatal result. In nearly every case the injury received has been concussion of the head, spine, or nervous system generally. In most cases this has been of a slight and fugitive character; in some, the symptoms have been more permanent.

The fatal case to which I have alluded was of an extremely interesting and instructive character. The man was hurled to the floor, together with some of the other officers engaged in their duties in the office. I visited him and the others very shortly after the occurrence of the accident. He assured me that he was not at all hurt, but merely shaken; and added that he intended to resume his duties at eight o'clock the same

evening. Although neither the pulse, the eye, nor the countenance showed any symptoms of serious mischief, I refused to allow him to return to duty, and, much against his own inclination, kept him quietly at home for some days—I think five. At the expiration of that time, as he had had no head symptoms, and the slight soreness he had admitted had disappeared, and as he had slept well, I allowed him to resume his work. For about three weeks he continued his duties, feeling no effect from his accident, except, as I afterwards learned, occasional slight headache during the last three or four days. At the end of that time I was requested to see him, as he was very ill and in bed. I visited him within an hour or so, and found him in a state of coma. He died the following day from serous effusion on the brain. A *post-mortem* examination was made, and no visceral or other disease was discovered to account for the cerebral affection.

One other serious and interesting case of concussion occurred in a large heavy man, who was thrown down with considerable violence. Severe head symptoms rapidly came on; and although the most appropriate counter-irritant and other treatment was at once had recourse to, and judiciously persevered in, delirium and loss of power of self-control were amongst the early consequences. He required continuous watching that he should not do himself an injury, as he attempted this on three or four occasions. I am happy to say that this case, although it occasioned considerable anxiety for many months, terminated in almost perfect recovery.

Nearly all the other cases of accident from collisions have resulted in the nervous system being shaken, and for a time, sometimes considerably, weakened. There

has been a great similarity of symptoms in nearly every case. Disturbed and diminished sleep, frequent starting when dozing, dreams of collisions, noises in the ears, feverishness, feeble pulse, much pallor, or, on the contrary, frequent flushing, and constipation, have been the symptoms common to almost all the cases of collision. In one case, tympanitis, lasting several weeks, showed itself. But these symptoms usually disappeared in periods varying, according to their intensity, from a few days to four or five months. In a few cases there has been some amount of debility and nervousness left behind; and in still fewer, loss of flesh, which sometimes has not been recovered for a considerable period. There is another sympton common to most of these cases of injury from concussion—namely, that the individual who has suffered therefrom is intolerant of railway motion for some little time after. When he is fit to resume duty, I generally recommend that he begin by taking short journeys at first.

With the object of preventing mischief to the officers engaged in the Post-office carriages in the case of collision or other accident, every sharp angle of woodwork in the interior of the carriages has been or will be rounded off, or done away with. Every hard portion of the internal fittings against which the officers might be thrown has been guarded with well-padded cushions. Every hook used for suspending the mail-bags has been either sunk in the woodwork or defended by a padded bar. All possible precautions have been taken to prevent mischief, and much benefit has already attended these alterations. Some attempts have been made at ventilation; but these have not been attended hitherto with the success I could wish. The Post-office carriages differ much from those

used by passengers. They are not divided by partitions, but are saloons, varying in length from twenty to twenty-seven feet.

Recommendations.—It will naturally be supposed that my attention cannot have been so much directed to the subject of railway travelling without having given some thought to the means of preventing or mitigating some of the inconveniences I have described. This is certainly the case; but I have considerable diffidence in making any suggestions on this point, as they are more in the province of the railway engineer or the carriage builder than in that of the sanitary physician. Still there are two or three that I think it right to allude to, as I cannot doubt that they could meet with easy application at the hands of a good practical engineer.

I am of opinion that springs could be constructed which, without weakening the attachment of the carriage to the frame, would prevent much of the vibration that, in my opinion, is one of the principal evils of railway travelling.

Cannot the carriages themselves be kept lower, so as to do away with some of the oscillatory movement?

Can no means of ventilating the carriages be found that will allow of the entrance of a sufficient supply of air, without creating thorough draughts or admitting the blinding dust and ashes from the furnace of the engine?

Conclusions.—The conclusions that I have come to from much observation are, amongst others, as follows:—

1. Railway travelling has little, if any, injurious effect on healthy, strong, and well-built young persons, if the amount be not excessive, and if they take moderate care of themselves.

2. Persons who take to habitual railway travelling

after twenty-five or thirty years of age, are sooner affected by it than those who begin earlier.

3. The more advanced in life a traveller is, the more easily is he affected by it.

4. Weak, tall, loosely-knit persons, and those suffering under the affections I have indicated, should, if possible, avoid this practice.

5. I am much inclined to believe that those who travel only occasionally, at uncertain intervals, or even as frequently as four or five times a week, are more obnoxious to the effects of railway travelling than those who, like our own officers, or the *employés* on railways, make it the special business of their lives. The constitutions and bodies of the latter seem to adapt themselves to the circumstances.

I must be permitted to append "a rider," by way of caution, to all these remarks. It is to the effect, that our experience of railway travelling is not sufficiently great to enable any person to state positively the *ultimate effects* of this new habit on the constitutions or health of the mass of people who thus travel.

CHAPTER IV.

THE RELATIONS OF RAILWAY TRAVELLING TO DISEASE.

THE first step towards the investigation of the influence upon health upon any given cause, is to estimate accurately the physical and mental conditions it produces, and determine their physiological relations to the healthy body. This has been done for railway travelling, for the first time, in this re-

port. It was the more necessary, because the effects are of subtle and complicated character; and because habitual railway travellers are subject to many various disturbing causes in their other relations of life to which no cognizance is given. It is, therefore, essential to have some means of correcting even actual experience by a rational investigation into the causes, character, and extent of the symptoms induced. There can be no doubt that hitherto many ailments have been credited to this cause which had a very different origin. On the other hand, there is reason to believe that many persons have treated the effects produced with undue carelessness, and, not being sufficiently on their guard, have suffered from persistence in a habit injurious to them.

But in place of the many vague surmises heretofore hazarded on this subject, we can now substitute accurate information as to the direct physical effects of railway travelling upon the body. These are, to produce a certain degree of muscular exertion; to increase the volume of air inspired; to quicken the circulation; to impress rapidly on the retina a succession of fleeting images; and to cause more or less increased afflux of blood to the brain and spinal cord, and some irritation of the gastric and sympathetic nerves by means of the vibratory movements of the body. Bearing in mind this general analysis of the effect of railway travelling, and giving due consideration to the circumstances which modify them, it becomes possible to estimate at their true value the complaints as to the various illnesses and diseases which have been ascribed to it. In no case is it more desirable to test, one by the other, clinical experience and physiological observation.

INFLUENCE ON THE BRAIN.—The pathological effects of railway travelling on the brain may be divided into two

heads :—1st, those which are the result of railway travelling where the brain is not previously diseased ; and, 2ndly, those which are observed to follow where the brain is already the subject of existing disorder.

It may, perhaps, be asserted that, unless a predisposition to brain disease exist, railway travelling is not likely to be productive of cerebral disturbance. The vast number of instances in which passengers and railway officials have habitually passed much time in travelling without suffering from brain disorder, favours that opinion. But much evidence has been laid before us to show that, where such predisposition does exist, railway travelling may become the exciting cause of cerebral disease. The first and most common symptom of disturbance thus produced is sleeplessness, with noise and singing in the ears. This is the earliest troublesome symptom of over-work amongst the experienced engine-drivers and guards. It has been especially complained of after some of the excessively long journeys—as to Manchester and back—which a parsimonious and most dangerous policy has recently imposed on them. The following case seems to illustrate the furthest and most serious effects of this kind of cerebral disturbance :—

Case of Cerebral Disease, by J. Sharpe, Esq., Waltham Cross.—"I have a case of a gentleman, with whose constitution and personal habits I am intimately acquainted, who for the last twelve years was actively employed by a large firm in business connected with the chief stations on all the principal lines. I may say he almost lived upon the lines. For some time he was unable to sleep at home in his bed, missing, as he said, 'the noise and motion of the rails.' His excitement has very much increased during the last twelve months, and he

is now compelled, by direction of his medical attendant, totally to abstain from business, and rusticate in the country. His brain is now showing decided symptoms of softening; and I much question whether he will ever again be able to resume business in any shape."

This may serve to illustrate the most distinct and marked effects of continued railway travelling where there is a tendency to softening of the brain. In such cases, Dr. Brown-Séquard, Dr. Forbes Winslow, Dr. Russell Reynolds, and other authorities, concur in considering railway travelling to be especially contra-indicated.

Case of Cerebral Disease, by Dr. Brown-Séquard. —Dr. Brown-Séquard has communicated to us some particulars of an instance in point, of a gentleman the subject of brain disorder diagnosed as a congestive affection of the pons Varolii. This patient resided a short distance from London, and the effect of a brief railway ride to town, for the purpose of consultation, was found distinctly and injuriously to increase the twitches and pains in the limbs (of the opposite side) which characterize this form of brain disease. This undesirable effect of railway travelling was so marked that Dr. Brown-Séquard found it necessary to prohibit his patient from coming by rail; and it was found that coach travelling was not productive of the same symptoms.

Cases of Affection of the Nervous System, by Dr. Radcliffe. — The following important cases of affection of the nervous system distinctly resulting from railway travelling have been communicated to us by Dr. Radcliffe. They are especially interesting from the fact that, in both, no other treatment was adopted than the cessation from travelling by railway,

and that the symptoms recurred immediately upon the patients resuming the practice :—

"A hale and stout gentleman, aged sixty-three, came to me, complaining of inability to sleep, numbness in the limbs, great depression, and all the symptoms of approaching paralytic seizure. He was very actively engaged in large monetary transactions, which were naturally a source of anxiety. He had a house in town; but, having been advised by the late Dr. Todd to live at Brighton, he had taken a house there, and travelled to and fro daily by the express train. The symptoms of which he complained began to appear about four months after taking up his residence at Brighton, and he had undergone a variety of treatment without benefit, and was just hesitating about trying homœopathy, when I saw him. I advised him to give up the journeys for a month, and to make the experiment of living quietly in town. In a fortnight his rest was perfectly restored, and the other symptoms rapidly disappeared, so that at the end of the month he was as well as ever again. After three months he was persuaded to join his family at Brighton again, and resumed his daily journeys. In a few days his rest became broken, and in two months all the old symptoms returned. By giving up the journeys and residing in town he was again perfectly restored; but it being the end of the season, when the house at Brighton could not be readily disposed of, and yielding to the wishes of his family, he again resumed his journeys. In a month's time he was rendered so seriously unwell that he hesitated no longer in taking up his permanent residence in town; and since this time (now more than two years ago) he has enjoyed perfect health.

"A barrister in large practice, about fifty years of age,

had a house about twenty miles from town, and travelled daily to and fro by rail. He complained that he found he was incapacitated for work on arriving in the morning, and that he was unable to bring his mind to bear properly on a subject until he had lunch, when the effect of the journey seemed to wear off; and that after the return journey he was unable to sleep, or did so but slightly. He had tried various plans—walking in the country, riding, &c.,—all of which only made him worse, and increased the feeling of *malaise*. Bearing in mind the former case, I strongly urged him to sleep in town for a time, and with the best results, for he found that his night's rest was restored, and that his intellect was as bright in the morning as it had formerly been. After some weeks, considering himself quite well, the country journeys were resumed, and with them the old troubles. In a month, indeed, all the old symptoms returned, and he was forced to relinquish his country residence. Since this time (more than twelve months ago) he has had no cause of complaint."

The following is an interesting case of evidently nervous affection of the heart, which was mistaken for serous disease of that organ, but which was rapidly relieved by the patient's giving up the practice which had produced his discomfort—the daily journey by rail, in this instance only over a short distance. For this case we are also indebted to Dr. Radcliffe :—

"A gentleman, aged thirty-four, holding an important Government appointment, took a house about fourteen miles away from the scene of his daily duties. After a few months, he suffered from palpitations, pain about the region of the heart, and a general feeling of anxiety. For this he consulted an eminent physician, who di-

agnosed serious organic mischief. This naturally distressed the patient considerably, and he was on the point of throwing up his appointment, when, coming to me, I suggested that he should try the effects of giving up his short daily journeys before taking so important a step. This was done; he was rapidly restored to health, and he has since had no indication of cardiac mischief."

Case of Epilepsy aggravated by Railway Travelling, by Dr. Anthony.—An important illustration of the effects of railway travelling upon the disordered brain is afforded by the following interesting case, communicated to us by John Anthony, M.D. Cantab., Physician to the Children's Hospital, and to the General Dispensary, Birmingham:—"Some few years ago I was travelling physician to a young officer in the army, who suffered from attacks of epilepsy about once or twice a month, and had done so for some years. Railroads at that time were not very common on the Continent, and our transit from place to place was generally by a comfortable travelling chariot, the motion of which seemed to have no sort of influence on the frequency of the epileptic seizures. But I had soon occasion to observe that whenever we had a few hours' journey by rail it was either followed by a series of epileptic seizures, or else the fits came on in the railway carriage, accompanied with so much congestion that a treatment of weeks was required to even get the system into its usual condition; these induced fits being out of all measure more severe than the usual seizures, which, as epileptic fits often do, seemed rather to relieve the system than otherwise. This effect of railway travelling on my poor patient was so marked and led to so much mischief that we were obliged to eschew travelling by rail altogether; and as

the rail in certain districts had quite driven away all post-horses, &c., we were put to curious shifts in order to make even an ordinary journey. For instance, in coming from Berlin to Hamburg by rail, the journey is made easily in seven or eight hours; but we had to make the passage by the rivers Spree and Elbe in a rickety boat, with its most wretched accommodation, involving (however absurd it may seem) an all but wreck on one of the mud-banks of the Elbe,—our transit occupying three days! My individual experience since that time goes to show that the constant vibration of railway travelling determines, either primarily or secondarily, a large amount of blood to the brain; and after a long railway journey I have known many persons to suffer for some days from extreme giddiness, accompanied by a deep flushing of the face and strong pulsation of the temporal arteries."

Apoplexy.—Where there is any reason to suspect a tendency to apoplexy, railway travelling should unquestionably be considered as an element of danger. Public attention has been more than once directed to this point by the occurrence of deaths from this cause in railway carriages. The sudden death of Lord Canterbury in a railway carriage caused the subject to be much discussed some few years since. A pamphlet on the subject was published by Dr. Badeley,* but was shortly afterwards withdrawn from circulation. Dr. Badeley discusses the subject with much good sense, and negatives the theory that apoplexy may be attributed to railway travelling in the ordinary course of events, although recognising the

* Is Railway Travelling conducive to Apoplexy? By J. C. Badeley, M.D. Cantab. London: Smith, Elder, and Co. Brighton: Robert Folthorp and Co. 1845.

impropriety of habitual railway travelling in persons who are predisposed to the disease. Many such cases have occurred, and their comparative frequency has naturally attracted attention. In a communication from Dr. W. Rogers, Winslow, Bucks, fourteen years surgeon to the railway works at Wolverton, he mentions having been called to several cases in which persons had been seized with apoplexy while travelling.

Sir R. Martin on Insolatio.—In a communication from Sir Ranald Martin, K.C.B., F.R.S., allusion is made to a similar experience of the inability to bear railway travelling under which persons labour who have suffered from such a weakness of the spinal cord and brain as follows upon sun-stroke. Sir Ranald Martin says:—"Many lamentable instances of the chronic sequelæ to sun-stroke have come under my observation during the last four years, the results of Indian service. Amongst the most deplorable were those of medical officers, because they knew the nature of the case and of its dangers. Many of them, the worst examples, complained much of the effects of railway movement, and some could not have recourse to this mode of travelling, even for very short distances, as the disturbance of the cerebral function and the increased uneasiness along the spine precluded their doing so."

It may be readily understood that where there is predisposition to spinal softening, the frequent concussions, and the congestion of the grey matter of the cord incidental to prolonged railway travelling, cannot fail to be prejudicial. The effects are illustrated by the instances referred to by Sir R. Martin. In the following case, occurring in the practice of the writer, the predisposition was not so clearly marked, but the effects were

completely observed, and they ceased upon discontinuing railway travelling, which was held to be the exciting cause :—

Case of Spinal Anæsthesia induced by Daily Travelling, by Mr. Ernest Hart.—"In November, 1859, a gentleman, actively interested in the work of the Rescue Society, came under my care with symptoms of spinal congestion, accompanied with loss of sensation in the lower limbs and lower half of the trunk, which at that time and subsequently I had reason to attribute to railway travelling. He was in the habit of travelling daily forty miles, to town and back, by a second-class carriage, with bare wooden benches, unprovided with cushions, on a line of railway of which the permanent way was then in a notoriously very rough state, so that the movement of the carriages was necessarily great. The symptoms indicated an affection of the sensory columns of the cord. They had existed for thirteen weeks before I was consulted. This patient was in the habit of sponging himself with cold water every morning, and he thus describes his condition in a written statement of his case.

"'I first noticed that when I passed the sponge over the right side, a little below the arm-pit, there was a space as large as the hand without the least feeling ; and round the edge of it there were sharp, shooting pains, as though fine hot wire were being drawn backwards and forwards. The space mentioned was quite devoid of feeling. Thinking it was caused by stagnation of the blood, I began rubbing the part with a piece of horse-hair cloth, until the skin began to chafe, but still without any sensation. This anæsthesia extended gradually downwards ; and under the same impression as to the

nature of the malady, I was in the habit of getting a hard brush, and using it with such force that the skin would peel off. I felt no pain, and so complete was the deadness of feeling that it was only by inspection I could satisfy myself that I was dressed. So devoid of feeling were the feet, that when standing in a crowd at the Lombard-street Post-office a gentleman trod heavily on my foot, and turned and begged my pardon. I had not felt him do it, but when I took my stocking off at night the skin was abraded from my toes. My previous health had been unexceptionably good, and, with this exception, was so when I was thus affected.'

"I desired this gentleman to abstain altogether from railway travelling, and to take up his residence in London. The therapeutical treatment which I employed consisted in iron, aloes, and strychnia, and subsequently Faradization, to aid in restoring sensation to the surface. In a recent communication from this gentleman (January the 8th, 1862), he says: 'In two months from the time of my first receiving your advice the feeling was restored in part, some days nearly perfect, at other times it would fall back again. In three months I may say that the feeling was perfectly restored, and I have enjoyed excellent health since that time.' This affection seemed to me at the time to be clearly attributable to the influence of habitual railway travelling on the hard benches of a second-class carriage. I could find no other exciting or predisposing cause. On removal of this cause, the spinal affection, which had been steadily increasing, yielded completely to treatment."

Where disease of the bones of the spine exists there is an obvious unfitness for habitual railway travelling; and persons affected with spinal curvature, or with other

grave affections of the vertebral column, need to exercise due caution in this respect. Where caries of the spine is present, it may be needful to employ careful precautions even for single and necessary journeys. On this point Mr. William Adams, surgeon to the Royal Orthopædic Hospital, has made the following communication :—

Mr. Wm. Adams on Railway Travelling in Diseases of the Vertebral Column. —With regard to the influence of railway travelling on persons affected with spinal curvature, the effects are so variable it would seem impossible to lay down any exact rule in reference to the extent or severity of the curvature and the pain or other symptoms caused by railway travelling. For example, many patients suffering from slight spinal curvature are quite unable to travel by railway; whilst we meet with cases of a severe form in patients who are not injuriously affected by it. For instance, a lady suffering from moderately severe lateral curvature, who travelled up from Exeter by railway — five hours' journey — suffered so much from the motion of the railway carriage that she was obliged throughout the journey to rest upon both arms by keeping them extended with the hands on the seat, and have the head supported, so as to prevent motion as far as possible; and even with these precautions a great deal of spinal pain and irritation was produced, from which she did not recover for several days. In another instance— that of a young gentleman affected with a very severe form of lateral curvature in the lumbar and lower dorsal region (altogether a very much more severe case than that just alluded to), who recently travelled up from Exeter to consult me—the patient bore the journey without any additional inconvenience whatever being

produced, although he had habitually suffered much more pain than the case previously mentioned. In another case, a lady affected with a very severe form of double lateral curvature, who occasionally travels up from Hull to see me, suffers so much from the journey as to be always confined to her bed for a few days afterwards, complaining of pain in the back, general prostration, and derangement of the liver.

Cases of this kind, in which the patient affected with curvature of the spine suffers more or less severely from railway travelling, frequently come under my observation. But at the same time we also see many cases of spinal curvature, sometimes of severe form, in which railway travelling is borne without inconvenience; and it is difficult to determine the circumstances, either in reference to the form and situation of the spinal curvature, or the constitutional condition of the patient, which lead to these different results. Speaking generally, the liability to pain co-exists with a disposition to increase in the spinal curvature; and old cases which have remained stationary or without increase for a long time are those which bear the railway travelling without inconvenience.

In cases of disease of the spine; *i. e.*, destructive disease of the ordinary form affecting the bodies of the vertebræ, railway travelling cannot be borne without much pain and inconvenience when the disease is in the early stage, or when it is actively progressing; but in the very chronic condition in which we frequently see this disease, I have known patients bear long railway journeys without much inconvenience, even though disease may still exist.

The physiological influence of railway travelling upon

vision has been already discussed; and from the character and rapidity of the retinal impressions, as well as the exposure to draughts of air, it may be understood how certain pathological effects may also result. These effects are amongst those most commonly recognized and provided against; the use of "railway goggles," smoked glasses, and other contrivances, being not uncommon amongst those who habitually travel by rail and are predisposed to any form of ophthalmic disease. The precise conditions clinically observed are described in the following communication, which we received from Mr. White Cooper, surgeon-oculist to the Queen and St. Mary's Hospital:—

Mr. White Cooper on the Sight as affected by Railway Travelling.—Daily experience convinces me of the injurious consequences to the eyesight which have followed the introduction of railway travelling, and with it the strong inducements to read whilst on the journey. In the majority of cases, the publications so read are cheap papers or books purchased at the station, printed in imperfect type on thin paper. Under the most favourable circumstances, there is on railways a vibration requiring incessant efforts on the part of the muscles and adjusting apparatus of the eyes to follow the shaking words, and in proportion as the carriages are ill-hung or the line rough are these efforts great. Many persons never can read in railway carriages; a sensation of swimming in the head speedily follows the attempt. There can be no doubt that the practice is fraught with danger; the effort is analogous to that made by the muscles of the body to maintain the equilibrium, whence proceeds much of the stiffness and fatigue inseparable from long journeys.

The occasional traveller who endeavours to read is obliged to pause from time to time to rest his eyes. The habitual railway reader finds the first indications of warning in the desire for more frequent pauses; the eyes are impatient of the strain, and the periods during which it can be borne become shorter and shorter. Supposing these warnings disregarded, the irritability of the eyes increases, and displays itself in ordinary reading, especially by artificial light; a peculiar sensation is felt, compelling the person to frequently close his eyes and press his hand upon them. Some complain of aching and darting pains; others of a "dragging" sensation, as if the eyes were pulled back into the sockets. In aggravated cases, the irritability and neuralgic tendency are such that the individual is debarred from all pursuits requiring persisting and steady vision. These symptoms, once established, are extremely difficult to remove, complete repose of the eyes during a lengthened period being in many instances absolutely essential.

Numerous tunnels on a railway create another evil; the sudden transition from darkness to bright light as the train rushes into the glare of day is especially hurtful to the large number of persons, whose studies have been interrupted by the darkness, and who recommence the perusal of their paper the moment the train emerges.

I have seen patients whose eyes have suffered severely from the pernicious practice of reading by lamp-light during night journeys; here is superadded to the ordinary evils that of imperfect, flickering light, with proportionally increased strain on the sight.

The annoyance and often injury to the eyes by particles of grit flying into them need only be referred to;

instances of violent inflammation and lasting injury have fallen under my notice.

It has been very frequently asserted by French and English physicians, that deafness may follow from the vibrations which affect the tympanum, as the result of the incessant noise in railway travelling. Deafness is one of the affections set down by Duchesne and others as most frequently following the labours of guards, drivers, &c. Our observations tend to this result amongst the English *employés*. Deafness, however, is a serious disqualification for a guard or driver; since, where the hearing is imperfect, or exists only on one side, the subject of it is often unable to distinguish the direction whence a sound—such as an alarm signal—proceeds. Hence the men rather conceal this defect from their employers, and it is probable that a considerable amount of unsuspected disease of the ears exists amongst them. On this subject we may quote a communication made to us by Mr. Harvey, F.R.C.S., Surgeon to the Royal Dispensary for Diseases of the Ear :—

My attention has long been directed to a certain class of disorders affecting chiefly the head, ear, and throat, resulting in deafness, neuralgic pains in the ear and face, and frequently in temporary paralysis of the facial nerve. In most of these affections, pains of a rheumatic character are more or less developed. They are to be traced to exposure to cold, and especially to draughts of cold air while travelling by railway in damp, wet weather during the autumn and winter months. I find, also, that most of these cases occur on the Northern and Eastern lines of rail, which pass through marshy districts. Cases have occurred, and are now occurring to me, in which certain persons otherwise in good health

have paid the penalty of a long railway journey in an attack of deafness or rheumatic headache, lasting for weeks, or even months, which the use of proper precaution would have avoided. To these cases, to their causes, and the peculiar and aggravating symptoms attending them, I directed attention as far back as 1851.* Both sexes appear to suffer, but females less so, probably because the face and head are covered, and therefore, to some extent, protected from the cold currents playing on those parts. So far, therefore, as concerns this mode of travelling, the results do not appear inevitable, but rather to arise from incaution and unnecessary exposure. The well-known anæsthetic influence of cold applied to the surface of the body will explain the paralysis and deformity and disturbance of the nervous centres that are observed in these cases. In the same way the continued draught of cold air driven into the external ear, and on to the membrane of the tympanum, will account for the temporary deafness and benumbed sensation so frequently complained of by travellers, and particularly those in commercial life, where journeys are taken at all seasons, and regardless of protection.

If healthy persons are thus subject to attacks of deafness and other evanescent symptoms about the head and face from this mode of travelling, how important it is that those who have a damaged organ, and especially that very common proof it, a discharge from one or both ears, should cautiously preserve themselves against cold! Those whose means enable them to travel in first-class

* On Rheumatism and Neuralgia of the Head and Ear. London: Renshaw.

carriages are evidently less exposed to the evils above-named than either second or third class passengers; but to the officials of the company, such as the engine-driver, stoker, and guard, it is attended with far more serious consequences. There are many at this time with diseased organs, who, had they been examined by competent persons, would have been dissuaded from the occupation. In some of these unhappy cases, not merely the organ of hearing, but life also has been endangered. And the risk, too, is not confined to the individual, but he is rendered incapable of satisfactorily discharging the duties of so responsible an office. I could mention many railway *employés* with only one sound ear who are now doing duty; and I ask what is the consequence of this imperfect hearing? When both ears are perfect, we can judge of the direction of sounds without turning the head, because the strength of the vibration is unequal on the two sides, and, by comparing the two impressions, instantaneously decide whence the sound proceeds; but when a person is deaf with one ear, the comparison is difficult; thus he is frequently obliged to turn his head in order to bring the tube of the ear in a line with the waves of sound, before he can ascertain whence it proceeds.

The chilliness experienced by railway travellers after waiting for the train on a cold, wet day, establishes a strong predisposition to the subsequent attack. The feet first become cold, the circulation is disturbed, the whole surface falls below the usual temperature, and any naturally weak organ is especially liable to failure. It is, therefore, impossible to avoid the conclusion, that strong currents of cold and damp air, added to the vibratory motion of the carriages, are the main cause of a class of diseases, to which, as connected with deafness, no one

appears to have directed observation until the introduction of railway travelling.

Quite recently I have had under my notice two persons, in whom headache, accompanied by deafness and incessant noises in the ears, was a prominent symptom, regularly produced by railway journeys taken to and from Brighton daily. These cases, and others in the same way, resisted all kinds of treatment, until the vibration and travelling were relinquished. I do not hesitate to say that disease of some portion of the ear may soon be lighted up by this cause, where any local predisposition exists.

The limits originally prescribed to this Report preclude the publication at length of those numerous communicated cases which, although varying very little *inter se*, yet prove how large is the professional experience accumulated on the subject, and how uniform the opinion prevalent among the most skilled observers as to the tendency of railway travelling to produce certain special influences both in health and disease.

From evidence already adduced, it cannot be doubted that in all cases where organic disease of the brain or nervous system exists long railway journeys are especially contra-indicated. Where this mode of travelling is necessary, it is the duty of the medical man, in cases of the above nature, to enjoin that every possible precaution shall be adopted during the journey, and to point out the necessity for rest immediately after its termination. It may be advisable in some cases even to counsel a change of route ; and the iron web of railways now lies so thickly over the country, that most of the health resorts can be reached without travelling over any particular line objectionable on account of its roughness, of the frequent

tunnels, or from other reasons which, although of little moment to a healthy person, become of serious import to the invalid. In reference to this subject, and continuing the consideration of the influence of railway travelling in various conditions of disease, we subjoin a further communication from Dr. C. J. B. Williams, F.R.S.

Noise and Shaking Motion of Railways. By Dr. C. J. B. Williams.—The bodily and mental fatigue induced by long journeys is mainly referable to the shaking and noise; and the indisputable fact that these operate more strongly in second and third class carriages than in first, at once indicates that they admit of considerable mitigation, if not of prevention. In fact, no one can have much experience in railway travelling without observing an extraordinary difference in the amount of noise and motion in trains on different lines. According to my experience, I would name as the smoothest and quietest of the great metropolitan lines, the Great Northern, the North Western (except in certain parts), and the Great Western (except also in certain parts, and except in the too common case of neglect in closely coupling the carriages). For noisiness, the Brighton line certainly carries off the palm, perhaps from the number and length of its tunnels and deep cuttings; but for *shakiness*, the South Eastern express trains have the pre-eminence, being only now and then equalled by the last ill-coupled carriages of a Great Western express train.

Now, these examples further suggest the inference, that if some railway lines are more shaky and noisy than others, this must be due to some defect in the construction of the line or of the carriages, or of both; and that if some trains on the same line have more motion and noise than others, it must be from something wrong in

the carriages themselves; and, as already hinted, one great fault is in the loose and careless manner in which the carriages are coupled together. That such easily preventable causes of injury and disturbance ought to be removed, is very obvious; and if railway directors and managers cannot be persuaded to enforce on their servants a due attention to this matter for the sake of the comfort and welfare of the passengers, perhaps they may be moved by the consideration that the shaking which wearies and bruises living bodies, also strains and wears unduly the rolling stock, and thus will add not only to the working expenses, but likewise to the risk of *costly* accidents. Any one well acquainted with the principles of mechanics and acoustics will scarcely fail to perceive that much improvement is possible in the construction of railway carriages, with the objects of diminishing their superfluous movement and noise.

The shaking motion of a railway carriage is commonly most felt in the back, loins, waist, and head; but any limb or part tender from disease is likely to suffer from it. The noise obviously most affects the head, and it adds much to the suffering and fatigue of those who are sensitive in the organ of hearing or in the membranes of the brain. But if the journey is prolonged, that which first excites pain and irritation may in the end cause faintness and exhaustion in weakly persons; and this may be followed by feverish reaction, lasting for some days. I know of some invalids who thus suffer so much from railway travelling that they therefore prefer to submit to the delay and inconvenience of posting.

Now, as before hinted, on these points railway carriages admit of much improvement; but until this is effected I would suggest extemporaneous means of mitigating the

motion and noise by means of air-cushions. A small horseshoe air-cushion around the neck of the traveller, and another of larger size around the loins, wonderfully intercept the noise and jarring motion of the carriages. All the motion and the worst of the noise are communicated through the solid walls of the carriages, and the head and back, leaning on them, feel the din and movement in proportion as they are imperfectly cushioned. Now the air-cushion muffles the vibrations more completely than any stuffing; and provided it be not too tightly distended, it isolates from much of the surrounding jar the part resting on it. An invalid thus *air-collared* and *air-girt*, with the legs on an easy foot-rest, and a pillow or cushion or two, if needed, to prop up against the rolling or lateral motion, may generally travel in a first-class carriage with more ease than in the special invalid beds. The noise might be further excluded by stuffing the ears with cotton-wool, but this causes a sensation disagreeable to some persons.

Some individuals suffer from vertigo, faintness, and nausea on riding backwards in any close carriage, and this effect is commonly greater with the increased speed of the train. I incline to think that this is caused by some disorder of the cerebral circulation, in a manner similar to sea-sickness. The backward motion promotes the afflux of blood to the anterior lobes of the brain, with a corresponding privation of it in the cerebellum and medulla, and disturbance of the functions of the trisplanchnic and associated nerves. Change of position is the obvious corrective of this evil,—riding forwards, with a current of fresh air on the face and forehead being the most effectual; but reclining on the side or back may also answer.

The motion and noise of railway carriages interfere more or less with the free exercise of the senses of sight and hearing. The attempt to read in a shaky carriage, especially small print, or any print, with an imperfect light, is trying to both eyes and head; and those with weak sight or liable to headache should not attempt it. So, also, the effort to carry on a conversation in a noisy carriage is irksome to both hearer and speaker, except in the case of certain deaf persons, who hear better in the midst of noise than usually.

Diseases of Respiration and Circulation. — In relation to patients labouring under actual disease (continues Dr. Williams), the influence of railway travelling is not so hurtful, according to my experience, as might be expected. I have known the subjects of advanced phthisis, subacute pleurisy, extensive disease of the heart, organic affections of the liver, stomach, and intestines, and dropsy, bear long journeys remarkably well, when due care is taken to protect them from draughts and the rougher motion of the carriages. Phthisical patients are often temporarily benefited by the motion and change of scene; and I have known some within a few days of their death travel a distance of several hours with little inconvenience. In a few instances hæmoptysis has been apparently brought on; but this has generally been in earlier stages of the malady, and referable to imprudent exertion in talking or other action. In all cases of recent extensive hæmoptysis or other kinds of hæmorrhage, travelling would be hazardous. The kinds of heart disease that suffer most from railway travelling are dilatation and fatty degeneration, in which the motion and flurry cause angina, with accompanying acute pain at the chest, and more or less faintness and irregularity

of action of the heart; in such cases journeys should be undertaken with caution, and all exertion or excitement avoided.

Here I would refer to a risk connected with railway travelling which applies more especially to the subjects of disease of the heart, but also in some degree to those of other maladies: that arising from hurry and anxiety about being late for a train. I never fail to caution patients with heart disease on this point. Better to be half an hour before the time, or wait patiently an hour or two for another train, than to incur any hurry of mind or body in endeavouring to catch a train. I have known sudden deaths, and several severe aggravations of valvular lesions, to be caused in this way.

Persons liable to spasmodic asthma sometimes have an attack during or after a railway journey; and when this is not the result of a cold caught, it may be from the dust attendant on this mode of travelling in dry weather.

Other disorders likely to be aggravated by railway travelling are, all congestive and inflammatory affections of the brain and spinal cord, and their membranes; and acute inflammations of almost any organ of importance in the body.

The following interesting case, from another source, forcibly illustrates an opinion above expressed:—A gentleman engaged at the Crystal Palace, who had occasionally suffered from spasmodic asthma, found that the daily railway journeys to and from London not only brought on frequent attacks of his ailment, but that these were increasing almost daily in severity and duration. Being unwilling to leave his town residence, he determined to try the effect of proceeding by the road

instead of the rail. The urgency of his attacks immediately lessened, and he rapidly improved. He returned to the railway travelling, and his asthma again resumed with increasing severity, until he once more changed his mode of conveyance. This alteration he repeated several times before being thoroughly convinced as to the cause of his increased suffering.

Retention of the Secretions.—Very many persons are exceedingly careless as to the necessary evacuation of the bladder and viscera before commencing a long railway journey. There is not in our railway carriages any arrangement such as exists in the long American cars for this purpose, and most persons can testify to the extreme annoyance, and even injury, which they have sometimes endured from undue retention. It is well known that habitual suppression of the desire for micturition is not only a cause of inflammatory affections of the bladder, but that it has become the cause of a reflex paralysis of the lower extremities. Such a case, occurring in the practice of an eminent physician, has been communicated to us. But a more direct instance of the evils of retention of the excretions is afforded in the following case, mentioned by Mr. Hilton recently in the *Lancet*, and described in his Lectures delivered at the College of Surgeons :—

"Just about this time two years since, a surgeon in the neighbourhood of London brought a gentleman to me under these circumstances. He said, 'He is rather an irritable man; he has pains and distressed feelings all over his left leg, and I want you to make out the cause of it.' I examined the leg carefully, and it seemed to me that the mischief, whatever it was, had been impressed upon the obturator and sciatic nerves. I made

some suggestions as to the cause of the symptoms, and he said, 'Well now, let us go into the other room, and I will tell you what happened.' This gentleman some time ago was going officially down to Southampton by the express. Before he started he was anxious to have his bowels opened, as they were rather relaxed, but he had not time. He got into the carriage, and travelled with great rapidity, but in great pain all the way to Southampton. I suppose he did not know the strength of his little sphincter ani, but he had to rely upon it in his emergency. As I have said, he sat quietly, but in great distress, until he got to Southampton, suffering great pain in his leg. Directly the train stopped, he jumped out of the carriage; his sphincter was taken by surprise, gave way, and then followed a deluge, with which he went to the water-closet, and there he left his drawers and stockings. That was the history and essence of his case. It was pressure upon the sciatic nerve and obturator, which seemed to have been extreme in the case of this nervous man, that led, I believe, to the painful symptoms respecting which I was consulted."

As mentioned previously by Mr. Partridge, paralysis of the bladder has been the consequence of unduly retaining the contents of this viscus during a railway journey. In a communication made to us by Dr. Waller Lewis, he observes:—

Cases of Affections of the Bladder and Kidneys, by Dr. W. Lewis.—Persons suffering from an irritable state of the bladder invariably have their complaint increased by railway travelling. This is partly due to the shaking this viscus undergoes, and partly to the necessity of the forced retention of the urine. A mail

guard formerly in the service of the post office was obliged to resign from this painful affection.

Affections of the kidneys are not only increased, but may even be caused by railway travelling, especially if long continued. One gentleman, who some years ago travelled day after day between London and Lancaster for six months together, informed me that he then suffered much from weakness of the spine and pain in the loins. Every morning the urine was invariably very high-coloured, "like blood," and quickly deposited a copious sediment. These symptoms showed themselves at no other period of his life but while doing this great amount of travelling.

A patient of mine, previously in perfect health, a remarkably strong, well-built man, was thrown with great violence during a collision, his back coming in contact with a wooden projection. He was much bruised in the region of the loins on either side of the spine, which latter did not seem to have received any injury. Considerable irritation and congestion of the kidneys supervened. Notwithstanding the most careful and assiduous treatment, hæmaturia came on. In spite of advice to the contrary, he has since been constantly travelling on the rail, and his disease has lately turned to pyelitis. As might be expected, he is now much reduced in size and strength. The symptoms of his disease have always increased in severity by the railway motion. He was in the habit of resting on Saturday and Sunday, began travelling again on Monday, and passed blood on Tuesday, after which there was no more blood till the following Tuesday.

It is believed that railway travelling requires to be studied in respect to influence on pregnant women, and

those affected with prolapsus, anteversion, and other uterine maladies.

In reference to the influence of railway travelling during the early periods of pregnancy we have received the following communication from Dr. Graily Hewitt, physician to the British Lying-in Hospital :—

Dr. G. Hewitt on Railway Travelling During Pregnancy.—It is well known that abortion may be produced by any violent exertion, by straining, or by sudden shock of the body generally. The question, therefore, as to the influence of railway travelling on the production of abortion is an interesting and important one.

It cannot be questioned that, in travelling long distances by rail, women are far less liable to have abortion produced thereby than was the case before the introduction of this mode of locomotion ; the proportion of cases of abortion due to jolting or excessive motion of the body during travelling is less than was formerly observed ; while, as it must be remembered, long journeys are now undertaken far more frequently than they used to be by pregnant women.

The joltings and shakings to which the body is exposed in travelling in ordinary vehicles over rough roads may produce abortion in two ways : first, by reason of the actual shock communicated, though modified as regards its force and degree during transmission, to the uterus, thereby inducing contraction of its tissue, and consequent abortion ; and, secondly, by that involuntary and instinctive contraction of the whole of the abdominal muscles which takes place whenever the body suddenly receives a shock. The body being thrown forwards or tilted to one side, an involuntary effort is made in the opposite direction, the general result being that the con-

tents of the abdominal cavity, including the uterus, are subjected to sudden unwonted pressure. When the trunk is thrown directly forwards, the pressure on the abdominal contents is increased by the flexion of the trunk on the thighs involved in this movement; this is likely to happen when in travelling the motion of the vehicle is suddenly arrested. The effects produced by the shocks and joltings incidental to railway travelling are identical in kind with those experienced in other ordinary vehicles; they are less in degree as a rule, but occur somewhat more abruptly. Now the physical conditions in which the uterus is placed are of the most favourable kind as regards their protective influence against any external disturbing agency, this organ being surrounded on all sides by soft yielding structures, and having no immediate relations with any portion of the solid framework of the body. Any slight impetus communicated to the body consequently produces hardly an appreciable disturbing influence on it or its contents, under ordinary circumstances at least. There are good reasons, however, for believing that the uterus is not equally protected against the disturbing influences in question during every portion of the period over which pregnancy extends.

The period of pregnancy at which abortion most frequently occurs is the third month—that is to say, taking into consideration abortion from *all* causes. The particular period, however, during which abortion is most likely to be produced by sudden physical shock may be stated as that included between the third and the fifth or sixth months. Before this time the uterus is wholly in the pelvis; later than this period it is wholly or almost completely so in the abdomen; while during the period

in question the tumour presented by the pregnant uterus is bounded in front and behind by two hard resisting osseous surfaces (the pubic bones and the sacral promontory), and is thus more liable at this particular time to be affected by external agencies of the kind now under consideration. The *à priori* reasoning leading to this conclusion is supported by the accurately-recorded observations of the celebrated Mauriceau. In 11 out of 130 cases of abortion from all causes recorded by this author, it is explicitly stated that abortion occurred in consequence of joltings or shakings received in travelling in carriages, or as a result of the fatigue attending long journeys. The average period of pregnancy at which the abortions from this cause happened was five months and a half. The rough roads and cumbersome vehicles of the period over which Mauriceau's observations extend—the close of the seventeenth century—were calculated to test the shock-sustaining ability of the pregnant uterus in the very best possible manner.

My own experience would lead me to the conclusion that the danger of producing abortion by railway travelling is slight so far as short distances are concerned, but that long journeys cannot be undertaken with impunity, or with freedom from risk of abortion. The fatigue consequent on maintenance of a somewhat constrained and uniform position during many hours must indirectly favour its occurrence; and shocks, however slight, when continuously applied during several successive hours, would have a more directly positive effect in the same direction.

It is difficult to estimate the exact influence of external agencies, such as external shock, in inducing the occurrence of *labour* at a later period than that included in

the foregoing remarks,—namely, towards the end of pregnancy,—for the reason that women are usually impressed with an idea that it is necessary to be more careful of themselves at this period, and, consequently, run less risks. When the natural time for delivery has nearly arrived, a slight external cause is sufficient to bring on the labour; and at such a time to take a long journey by rail, or, indeed, by any other mode of conveyance, would, unquestionably, be likely to hasten the occurrence of labour.

Dr. Meadows, assistant-physician for diseases of women and children at King's College Hospital, has made the following communication to us:—

Cases of Abortion and Hæmorrhage, by Dr. Meadows. — Mrs. P——, aged twenty-seven, pregnant at seventh month with second child (first born at full time), travelled from Ipswich to London by express—a distance of seventy miles; began to feel uncomfortable during the last half-hour of the journey, and was taken in labour the same evening, about two hours after arrival. There was obstinate flooding before birth of child, much worse after, and from the effects of which she died the following morning.

There can be little doubt, I think, that in this case labour was brought on by the peculiar motion of the train. Probably the placenta was slightly separated from its attachment, as the hæmorrhage before the birth indicates; and this may have been in consequence of some morbid condition of the placenta; as, however, we cannot always diagnose this before expulsion, its possible existence, and the mere liability to detachment, necessitate more than ordinary care.

Mrs. W——, aged thirty-four, pregnant at the tenth

week, travelled by rail from Edinburgh to London. A slight "show" began while in the train; it increased after her arrival; but, by employment of astringents with opiates (acetate of lead and opium) and absolute rest and quiet, no further mischief ensued.

Here, I believe, some portion of the ovum was separated; but no uterine action being excited, as evidenced by absence of pain, medicine was able to check its progress, the disturbance was quieted by perfect rest and sedatives, and the patient went to full time.

Mrs. G——, aged forty, pregnant at the fourteenth week with the seventh child, travelled by rail from Torquay to London. Pain and hæmorrhage began in the train, and within half an hour after her arrival in London the ovum was expelled with considerable hæmorrhage.

My own impression is, that there is greater danger to pregnant women in travelling by rail in the latter than in the earlier months of gestation; as I believe that then, especially in the last month or six weeks, there is much greater liability to uterine action being set up than in the early months. I have often known labour brought on by a drive after the eighth month.

At the hospital, out-patients suffering from polypus and cancer of the uterus have several times told me that in coming up by rail so short a distance as from Greenwich, Richmond, or the like, they have observed that bleeding frequently followed the journey. Travelling by omnibus is especially prone to do this. All which shows the tendency to some disturbance in the diseased structures.

INFLUENCE OF RAILWAY TRAVELLING ON DYSPEPTICS.—

The large majority of those persons who adopt habitual railway travelling to and from their places of business (led to do so by a recognition of failing health) suffer from some form of dyspepsia; at least, this they assume to be their ailment, because to it are attributable the symptoms they chiefly experience. For the wear and tear of constant anxious occupation, with little healthy exercise, manifests its effects throughout the whole system; and the diminished tone and vigour, the irresistible longing for some change, are only general confessions of how much the bodily health is below par. But the digestion, suffering only as the rest suffers, is usually made the scapegoat in these cases; on it all the blame is laid, and to it alone is the attention specially directed. Hence we understand why, in many cases, habitual railway travellers state that the symptoms they have watched and gauged improve greatly with the change of life, but suspect that some new trouble, some alarming indications of nervous disease hitherto unnoticed, are developing themselves as the result of railway travelling. The real truth, of course, is, that these were coincident in cause and origin with the dyspeptic symptoms, but that the attention was concentrated on the latter.

We have already described the physiological reasons why the peculiar motion of railway travelling tends to affect injuriously persons in whom the sympathetic and pneumogastric nerves are either extremely susceptible or have been unduly irritated. In some the motion of a railway carriage will produce absolute vomiting; and many instances have been communicated to us where vertigo and nausea similar to those preceding sea-sickness, or produced by an irritant in the stomach causing

reflex action to bring about its own ejection, have so troubled travellers that rest after every journey was absolutely necessary before any exercise or food could be taken.

"Some of the worst cases of dyspepsia I meet with," writes a gentleman, with large opportunities of observation, "are amongst persons who habitually hurry over their breakfasts to catch the train; and who have to work their very hardest in the day that they may be at the station in time to get down to a late heavy dinner in the evening. Such people are dissatisfied because the change into the country does not set them up, forgetting that even the healthiest person could not long bear the lives of regularly-renewed excitement they lead: their meals, railway journeys, and their business all being done under a condition of excitement and a sense of racing against time."

Influence on the Liver.—In cases of that common hepatic derangement which is dependent on sluggish action of the liver, railway travelling appears to be beneficial rather than otherwise, although the peculiar character of the motion, and the sitting in a position which requires a constant steadying effort, have in several cases been mentioned as the cause of portal congestion, of hæmorrhoids, of hæmorrhage in chronic dysentery, and stomach diseases. There is grave reason to believe that the recent death of a celebrated physician from this latter cause was to some extent attributable to the long railway journeys he was frequently required to undertake.

The following valuable remarks concerning the influence of railway travelling in diseased conditions of the abdominal viscera have been communicated to us by Dr. Brinton, physician to St. Thomas's Hospital:—

INFLUENCE ON DISEASES OF THE ABDOMINAL VISCERA. In respect to the influence of railway travelling on diseases of the abdominal viscera, my experience suggests two propositions. First, this mode of travelling, by its influence on the nervous system, is capable of increasing or aggravating many of these maladies, and especially of increasing such of their symptoms as are known to be connected chiefly with debility and exhaustion, to an extent which (though certainly much less considerable and general than the increase of cerebro-spinal exhaustion, which it is well known sometimes to produce) is occasionally an important addition to the original malady. As illustrations of such aggravations, I would cite the increase of pain, nausea, vomiting, prostration, &c., which a long railway journey may often be noticed to bring about in cases of this kind. As qualifications of such a statement, however, I would point out that it may be questioned whether railway travelling, as distinguished from other forms of passive movement, exerts any specific influence, save perchance as a form of travelling which acts more slowly and insidiously, and thus more easily tempts a patient beyond the bounds of his strength than a carriage journey.

The second proposition I regard as much more specific and important—namely, the marked influence of railway travelling in provoking hæmorrhage. So many and unmistakable are the instances of this kind which I have seen, that I am forced to believe it to be no very uncommon effect of railway travelling in persons predisposed to such bleedings. Epistaxis, hæmoptysis (laryngeal and pulmonic, the latter both tubercular and cardiac); gastric, hepatic, intestinal (in all three both ulcerative and obstructive), and hæmorrhoidal bleedings of this

kind, I have frequently traced to this exciting cause. The practical remedy for cases in which such causes are present is obvious enough: to reduce the extent and frequency of railway journeys to the *minimum* which circumstances necessitate; or, conversely, to estimate the amount of railway travelling which such persons can safely effect as something considerably less than that which their age, conformation, habits, and even experience during health, would otherwise represent as innocuous. The excess is often so purely relative, that a simple precaution of this kind at once obviates all such results. For example, I am acquainted with a gentleman, in whom three successive days of railway travel rarely fail to produce an epistaxis, which any other cause—including any ordinary day's travel of 200 or 300 miles—fails to produce. And I have in my recollection, while writing these lines, one or two cases of dangerous hæmorrhage thus excited and restrained, in which the diagnosis—gastric ulcer in some, cirrhosis in others—has been since confirmed by a necropsy.

On Abdominal Tumours.—In cases of abdominal enlargement, as in ovarian disease, in ascites, or where the parietes are thickly laden with fat, the mechanical influence of the motion in a railway carriage often becomes most distressing, more so than in any other kind of conveyance, and frequently requires days to recover from its effects. The following interesting account, communicated by an eminent hospital surgeon, significantly points out how in an extreme case this effect may proceed to even a dangerous extent:—

Mechanical Influence on Corpulent People.—At a short period after the opening of the railroad from Leipsic to Berlin (I think it was in the summer of

1841), I was travelling in a first-class carriage to the latter city. I had for my companion a very corpulent man, upwards of sixty years of age, formerly an officer of rank in the Prussian army. The train was lightly laden and the carriages loosely coupled, and we had not proceeded far before we found the motion of the carriage most inconvenient, and, indeed, to my fellow-traveller most distressing, in consequence of the shaking of his enormous abdomen. I placed him in the centre compartment of the carriage, persuaded him to press his feet firmly against the opposite seat, packed him in his seat with great coats, &c.; but in vain. His cries were piteous, and his aspect, as we approached the end of our journey, really alarming. For the last four or five hours I sat opposite to him, at his request, endeavouring to prevent his pendulous belly swaying from side to side with the motion of the carriage. As I was myself subject to the same motion, of course the efforts were not very effectual, although my companion said it was the only ease he obtained. On arriving at Berlin, I took my fellow-traveller to his lodgings in a carriage, at a foot-pace, and placed him under medical treatment. I called two days afterwards, and found him in bed. He was extremely ill, I thought, dangerously. He showed me his abdomen, which was covered with lotions. It was one enormous bruise, livid as intestine after three days' strangulation. There were reasons which made it undesirable to form a very close intimacy with the colonel, and therefore I did not watch his progress narrowly; but I am able to say that he recovered slowly, and after about two months was able to leave Berlin on his journey further north.

CHAPTER V.

SECONDARY EFFECTS OF RAILWAY ACCIDENTS.

IT would appear, from the evidence on various trials which have been instituted to recover compensation from railway companies, that neither the direct shocks produced by the accident, nor the physical injury inflicted at the time, afford any trustworthy indication of those insidious results which may subsequently ensue at a more or less distant period. That these are chiefly due to the violent concussion of the nervous centres experienced during the shock, is clearly shown by the character of the symptoms presented: tingling and numbness of the extremities, local paralysis, paraplegia, functional lesions of the kidneys and bladder; and sometimes those slowly-ensuing symptoms of intellectual derangement long since observed to occur in certain cases of severe cerebral concussion. Symptoms such as these, slowly and insidiously coming on, have especially attracted notice by their frequent occurrence after severe railway accidents. The vehemence and suddenness of the jolts experienced during a collision exceed in violence any other kind of shock to which human beings are exposed in travelling. The cases hitherto recorded seem to indicate that heavy and robust persons, as might be anticipated, are especially liable to suffer in the way here described. And there is reason to suspect that in many cases the subsequent occurrence of severe symptoms may be traced to carelessness. Persons escape the immediate danger, and,

believing that they are uninjured beyond the severe mental impression of fright, go on their way rejoicing, and neglect the necessary precaution of affording that long period of perfect rest to the brain and spinal column which may enable them to recover from the shock. It is interesting to remark that the effects which slowly ensue in a previously healthy person after such a violent concussion resemble in a more intense degree those symptoms distinctly traced, in cases already related, to the recurring small concussions experienced during prolonged railway travelling.

The description given by Dr. Waller Lewis (in the second report), of cases where secondary effects ensued after violent concussions during railway accidents, represents very accurately the most prominent characteristics detailed in all the instances communicated to us of similar injuries.

No precise limit has yet been fixed beyond which the law refuses to admit that actions for damages may be sustained, although this point has been several times mooted in court. These public trials, however, represent but a very small proportion of the cases in which compensation is paid by the railway companies, and the matter is kept as much as possible from public notice. In the year 1860, the enormous sum of £181,270 was paid as compensation for damages sustained by railway accidents.

In order to illustrate these observations, we will refer to some of the more remarkable trials which have occurred during the last few years.

An accident happened to the mail-train on the London and North-Western Railway, whilst passing over the Trent Valley portion of the line, on November 15, 1860,

which gave rise to several trials brought by Post-office officials for compensation for injuries received. The nature of the accident may be described in a few words, the facts being, that the mail-train, whilst going at full speed, ran into a cattle-train at a road-side station, killing several of the drovers, and inflicting a great amount of damage on its own passengers. In the case of Laughton *v.* London and North-Western Railway, tried July 1, 1861, it was proved that the plaintiff, one of the sorting-clerks, had been thrown from one end of the carriage to the other, when he fell on the back of his neck, and was for a moment insensible. He was able to proceed to London the next morning, when he was seen by Dr. Waller Lewis, who found him suffering from giddiness, loss of memory, pains in the back and head, &c. It was shown that he had been obliged to go into the country for some time, and had been unable to perform his duties. Dr. Waller Lewis, Dr. Cornelius Webb, Dr. Farre, Mr. Gay, Mr. Bennett, and Mr. Morgan (the latter of whom saw the patient immediately after the accident), agreed in stating that the plaintiff had received a concussion of the brain and spinal cord; and that, though ultimate recovery was possible, it was certainly doubtful, and must be remote. On the other hand, Mr. Skelding (surgeon to the Company), Mr. Arnott, and Mr. Holt, having examined the patient, had come to the conclusion that there was nothing the matter with him! The jury, however, gave damages of £275.

Another case, arising out of the same accident, was that of Hill *v.* the London and North-Western Railway. Hill was acting mail-guard, and had his head cut open and his back injured. Dr. Lewis found him flushed and excited, becoming suddenly pale and then flushing again.

He was in a very nervous condition, with a weak and rapid pulse. He had sustained a severe scalp wound at the back of his head, and complained of headache, swimming in the head, and unnatural affection of sight. He had been obliged to give up his usual work and take lighter employment. Drs. Farre and Webb confirmed this account, and said that the patient was still suffering, and would do so for some time. Messrs. Lawrence, Skey, and Oliver Pemberton, considered that, whatever might have been the immediate effects of the accident, he had quite recovered from them at the time of the trial, which took place on the 1st of July, 1861, or eight months and a half after its occurrence. Verdict for £150.

In both these cases, it may be noted that the symptoms, though not very grave, lasted for a considerable time; but it is not a little remarkable how conflicting the medical evidence was upon their probable duration. Since there can be no doubt, from the evidence of the medical men who saw the plaintiffs immediately after the accident, that they had sustained injury, the question for the jury was principally as to the duration of the effects; and, seeing that the medical authorities differed, they, after the manner of juries when in doubt, found verdicts for the sums asked.

Another remarkable cause was tried on the 1st of July, 1861—viz., that of Salmon *v.* the London and North-Western Railway Company. The plaintiff was in a train which was run into by the mail-train at Camden Town on the 8th of January preceding. He was thrown forward, had his head cut open, and his legs and back severely bruised. He was ill for some time, and had to go to Brighton to recruit. According to his own statement at the trial, his nervous system had sustained a

shock, and he found himself unable to attend to business as he had before done. The medical evidence showed that he was suffering from great weakness, with a quick and irregular pulse, which had risen to 140 a minute during the examination in court. He had some hesitation of speech and difficulty of locomotion. Messrs. Lawrence, Skey, and Holt, for the defence, said that, having examined the plaintiff carefully, they thought that there was no reason why he should not go on with his work as well as before the accident. Mr. Lawrence, in addition, considered that the character of the pulse was constitutional.

A remarkable case (Shepherd *v.* the London and North-Western Railway Company) formed the subject of a trial at Oxford on the 13th July, 1858. It appeared that the train in which the plaintiff was travelling ran off the line on the 22nd March of the same year, when he was thrown violently about the carriage, and other passengers were thrown atop of him. He did not complain of any special injury at the time, and was able to walk about the scene of the accident, and to examine the defective arrangement of the rails; and on arriving at his destination he wrote a letter to the *Times* upon the subject. The next day he went to his office by omnibus, when, finding himself unfit for business, he returned home immediately, took to his bed for some days, and was obliged to go into the country to recover his health. According to his own account, he received a blow on the side, which caused him to pass blood for two or three days; also a blow on the head, which left no bruise, but only a puffiness. His chief complaint at the time of the trial was a feeling of nervous depression, and particularly that the countenances of his fellow-passengers, with

terrified eyes, would come before him whenever he attempted to do any reading or writing. Previous to the accident he had been able to drink one or two bottles of wine at a sitting, but since that time a single glass was his limit. Mr. Fergusson and others thought that the plaintiff would eventually recover, but probably not for twelve months. Messrs. Lawrence and Skey, on the other hand, thought that he was enjoying fair average health, and that the symptoms described were exaggerated. The jury gave £700 damages.

The above case illustrates exceedingly well the absence of immediate effects, and the more remote consequences which may follow an accident of the kind described. It is hardly likely that such a symptom as the optical illusion of the appearance of the other passengers' faces could have been invented; and the fact of the inability to take more than a single glass of wine is confirmed by our daily experience of cases of injury to the head.

The following case is even more interesting, from the time which intervened between the accident and the full development of the symptoms :—

Wright *v.* the North-Eastern Railway Company, July 4th, 1859. The plaintiff was thrown forward by a collision in August, 1857 (nearly two years before the trial). She continued her journey to Doncaster, where for three weeks she was without medical advice, but suffered during that time from nervous symptoms of a peculiar character (particulars not stated in report of trial). In March, 1858, the symptoms had increased, and she saw Dr. Walshe, who at once referred her symptoms to their true cause. She gradually lost power in her right hand, which was useless at the time of the trial. There being

no doubt as to the facts, the company consented to a verdict of £450.

Our space will not allow us to quote all the cases which might be brought to bear upon the question, but we may refer to the causes of Nicholson *v.* the London and North-Western Railway Company, Killeen *v.* the London and North-Western Railway Company, Ridley *v.* the London and North-Western Railway Company, Wallis *v.* the London and North-Western Railway Company, and many others of earlier date, in which the medical evidence was of the most contradictory nature.

In the following two cases, points of special interest were involved, certain peculiar effects upon the organs of vision forming the greater part of the alleged injury for which compensation was claimed :—

In that of Williams *v.* the Great Northern Railway Company (Dec. 11th, 1860), the plaintiff was travelling in a carriage which was allowed to run through the King's Cross station into the road beyond, on May 28th of the same year. His head and shoulder were injured, but he was able to walk to his lodgings. The next day he attempted to transact business, but felt ill and returned to Liverpool, where his medical attendant examined him, and found a contusion over the temporal bone, one on the shoulder, and loss of power in the arm ; a bruise was found in the lumbar region ; there was numbness of the lower extremities, great depression of spirits, and an inability to describe what had happened to him. The brain had been disturbed, causing an affection or injury of the optic nerve. The plaintiff complained that *all objects appeared yellow to him.* Mr. Quain (with Dr. Owen Rees) had examined the plaintiff, and found that the principal injury was to the brain,

which accounted for the want of intelligence he noticed in him, as well as the defectiveness of vision. Mr. Coulson and other surgeons, for the defence, thought that entire recovery was probable, but could not account for the fact of the yellow vision. The jury gave £1,200 damages.

There does not appear to have been any ophthalmoscopic examination of the eyes in this case, which is to be regretted; for had there been any changes in the vitreous humour, or any effusions about the choroid, &c., they would have been readily recognized by an experienced observer. As it is, the case rests entirely upon the testimony of the plaintiff, who may have made the most of his ailments, although, being a corn-factor, the discrimination between white and yellow was no doubt of importance to him.

The case of Clements *v.* the London and North-Western Railway Company was another of the trials arising out of the accident to the mail-train in November, 1860, to which we have before alluded; but it differed from the former case in the fact that the plaintiff had sustained injuries in a previous accident at Rugby, in March, 1859. The plaintiff was a letter-sorter, and was thrown a distance of twenty-two feet, and several of his companions were thrown on him. It was alleged that he had received an injury to the spine, and that his eyes were affected by the shock. At the close of the plaintiff's case a suggestion was made that he should allow his eyes to be examined by Mr. Haynes Walton with the ophthalmoscope, to which he refused to consent. For the defence it was urged that the injuries were exaggerated; and several surgeons stated that they had examined the plaintiff, and could not discover the slightest indication of his having sustained any injury to

the spine ; and, with regard to the eyes, they stated that he was suffering from asthenopia, the result of over-taxing his eyes by lamplight, and that their condition was not attributable to the accident. The jury gave a verdict of £275 damages.

Mr. Poland, of Guy's Hospital, was one of the surgeons called by the plaintiff, and he has made the case the subject of remarks in some "Medico-Legal Observations in Connexion with Lesions of the Eye," from which we extract the following :—"There is no question about the man having sustained an injury ; but the amount of damages depended upon the fact of impaired vision incapacitating him for his employment for an indefinite period. The evidence on this point put before the jury by the counsel for the plaintiff was of an extremely moderate and fair kind. One of the medical witnesses deposed that he had made a careful examination of the plaintiff's eyes on the day preceding the trial, and that he found that the patient could see to read at the ordinary ranges clearly and distinctly, but after some time the vision became confused, the letters running into each other, so that he was unable to make out the words. The field of vision was found very defective, for only a small area about the centre was clear, and that vision gradually faded away and was entirely lost considerably within the natural ordinary limits. By the ophthalmoscope nothing abnormal could be seen, nor could any structural changes be detected sufficient to account for the impaired vision. The witness considered the effects to be referable to shock to the nervous system, and general debility arising from the injury received.

"The defence set up was that the impaired vision was not due to the accident at all, but was a sequence of his employment as a Post-office letter-sorter; and the counsel for the defence put the following question (or words to the same effect) to the plaintiff's medical witness: 'Do you know of any employment more serious and detrimental to the sight than the occupation of a letter-sorter, who has to sort letters for many hours with great rapidity, his eyes being exposed at the same time to a strong artificial light?' The medical witness declined answering the question, as having had no experience in the matter; he was attached to a large Ophthalmic Hospital, and had but rarely met with cases from the Post-offices suffering from impaired vision, and could not conscientiously affirm the question. A great deal of unnecessary quibbling took place on behalf of the plaintiff, through his counsel refusing to allow of his eyes being examined by the defendants' medical witness with the ophthalmoscope. There was no occasion for this at all, as the plaintiff's witness had already done so the day before, and had found nothing unnatural in the eye itself. The medical witnesses for the defence seemed to have utterly ignored the fact of the man having had no defective sight up to the time of the accident, he being at that moment in active employment in sorting letters."

Mr. Ernest Hart states, as the general result of his examination of the subject, that the conclusion is justifiable, that the secondary effects of accidents are often far more serious than the primary; and this principally through the ultimate impairment of the nervous forces. It is generally remarked that the results of injuries are over-

stated; but he has reason to believe that it is equally true that at many trials the ultimate effects have not been foreseen, and the amount of injury has been understated.

CHAPTER VI.

PRECAUTIONS AND IMPROVEMENTS SUGGESTED.

SAFETY, HEALTH, AND COMFORT OF TRAVELLERS.—We have considered the things which concern safety in railway travelling and those which affect the comfort of passengers as demanding attention equally with those that influence their health. They tend to the same goal. For what produces mere discomfort in one person is a serious annoyance to another of greater susceptibility, and becomes absolutely detrimental to health in a third. And any cause whereby life is endangered has an obvious claim to be regarded as influencing health in a very pronounced manner.

In recording the general conclusions to which the present investigations have led, it is not expedient to follow exactly that order hitherto maintained, as such a course would involve unnecessary repetition. But, so far as may be, we will consider separately accidents whereby life and limb are endangered, with the means for their prevention; and the influence of railway travelling on healthy and diseased persons, with the precautions requisite for ensuring the health and comfort of travellers.

PUBLIC SAFETY.

THAT impression which has already taken deep root in the public mind as to the faulty adaptation of railways to the requirements of passenger traffic has certainly not found any reassuring refutation in the evidence on which these reports have been founded, nor in the elaborate articles on Railway Management and its Control, recently published in two of the *Quarterly Reviews*. It would appear, indeed, that the business energies of the management on many lines are more devoted to the development of excursion or goods traffic than to ensuring the safety of passengers; and the latter fault has been carried to such an extent as to draw the following remonstrance from one of the Government inspectors of accidents :—

"*Sept. 6th*, 1860.—I am sorry to be obliged to state that this accident brings forward additional evidence that there is great laxity of discipline on the line. In making this statement, I am assuming that the directors, in issuing printed books of regulations, wish them to be observed. If they have no such wish, the sooner these printed regulations are thrown away the better . . . . This collision is another exemplification of the reckless way in which the lives of the public are risked; and the company appear to take more care of goods than they do of human beings."

PARLIAMENTARY INTERFERENCE. — But if there has been culpable heedlessness as to the welfare of the 163 millions of lives yearly intrusted to the charge of railway companies, it might be supposed that stringent laws would soon be introduced and passed by the Legislature to enforce attention to the safe conduct of this vast multitude of persons; that they would be protected by enactments bristling with penal clauses; and that the statute-book, which throws its ægis round pheasants and partridges, would also contain laws for the better protec-

tion of railway passengers. It is true there is legal provision for recovering compensation when injured by a railway accident; but of authoritative control for prevention of such accidents occurring, there is really none of any efficacy. We may refer, in illustration, to that great public loss which the death of Dr. Baly occasioned. No amount of damages could compensate for the destruction of such a life. Yet there is no line and no train to which a similar accident may not occur to-morrow, so far as any preventive measures exist. As the strength of a chain is the strength of its weakest link, so the safety of a railway must be gauged by its most defective part, remembering that there is equal strain on all. It is the fable of Achilles with his vulnerable heel constantly exposed. For the death of Dr. Baly was due to an imperfect condition of the line. Its state was so bad as to produce an amount of oscillation which threw the train off the rails. To remedy such a state of things, there is, first, a Government inspection of the condition of the line; and, secondly, a report by Government officials whenever an accident occurs. How these are practically disregarded by the companies, or openly defied, may be surmised from the following extracts from official reports to the Board of Trade :—

"*April* 11*th*, 1860.—This is the third case which I have had to report on, in the course of the last twelve months, where railway companies have made alterations in their line, prejudicial to the public safety, subsequent to the sanction for opening being given by their lordships or the Commissioners of Railways."

"*Feb.* 9*th*, 1861.—The superintendent of the line said that the directors and officers of the Midland Railway Company considered that, with their large experience, they were far more competent to judge of the safest mode of conducting their traffic than any engineer officer sent down by the Board of Trade to inquire into the circumstances connected with an accident, could possibly be . . . . I beg, therefore, to submit for their lordships' consideration

the inutility of sending any of their inspecting officers to inquire into the causes of accidents on the Midland Railway. The recommendations of these inspecting officers may be met by the same kind of reply as was given on this occasion."

RAILWAY INDIFFERENCE TO GOVERNMENT REPRESENTATIONS.—The companies condescend to throw an occasional sop to Cerberus by making some trifling alteration which should have been so done as to prevent the accident; but in whatever concerns the wide issues on which life and death depend, they pay little or no attention to the most forcible representations of the Government inspectors. The large companies exert too powerful an influence to fear interference, and the smaller ones profess great deference to the main lines with which they are in connection.

"In this manner, one powerful company, adopting vicious modes of working, and setting itself against improvement, acts prejudicially upon the companies which work with it, affects other companies again through them, and, both by example and by practice, does injury to the whole railway system, and is the occasion of unnecessary risk to a large proportion of the travelling public."—*Government Inspectors' Report, Feb. 6th,* 1861.

The official reports go to the Board of Trade, and so into blue-books and oblivion. The Board of Trade is content to know that there are inspectors; and the work of protecting the public is supposed to be done when a report has been printed, even though that report, as is usually the case, points out the absolute necessity for enforcing precautionary measures. "The directors care more"—we learn from good authority—"for a letter in the *Times* than for the most condemnatory report." The one influences the public and the traffic; the other no one reads but officials. And how these read and profit by the contents of these reports a recent Parliamentary episode will best show :—

How not to do it.—In the House of Commons, on the 14th of February, Mr. Bentinck asked the President of the Board of Trade whether, in consequence of the repeated occurrence of railway accidents, it was the intention of Her Majesty's Government to introduce during the present session any measure founded on the Report of the Committee on Railway Accidents? Mr. M. Gibson said it did not appear, from the reports made by the inspectors on recent railway accidents to the Board of Trade, that any new circumstances had lately arisen to render desirable the interference of Government in the management of railways.

Now, these are some extracts from the recent official reports referred to :—

"*May* 30*th*, 1860.—The suggestions of the inspecting officers and their lordships' urgent representations on the subject, though repeatedly made, are thrown aside as entirely impracticable."

"*Nov.* 19*th*, 1860.—Looking to the frequency of boiler explosions, it becomes a question for serious consideration whether it is not desirable that precautions should be enforced by law. If such precautions were properly enforced, these explosions would be as rare as they are now frequent."

"*Jan.* 18*th*, 1861.—Had the passengers had any means of communication with the guard in the van in front of their carriage, when they first became aware that something was wrong, they need not have been carried for miles under such circumstances of extreme peril. But it seems hopeless to expect that railway companies will do anything in this matter, unless the Legislature compels them to do so. I am afraid it is hopeless to expect any improvement, and I know that it is useless for an inspecting officer to continue to call attention to it."

"*Feb.* 21*st*, 1861.—If warning were taken from accidents of this kind occurring, not only on one, but on most of the railways in England, improvements might be introduced similar to those which have on some lines been adopted; but with the studied persistence in such a vicious system, the reports of the inspecting officers might almost as well not be made, as they appear to serve no other

useful purpose than to give the sufferers in railway accidents, or their representatives, a clue on which to base their demands for compensation."

"*April 4th*, 1861.—The collision was undoubtedly the almost inevitable result of the vicious system of working, by which one train is allowed, in defiance of the company's printed regulations, to follow another at a distance of from 60 or 70 to 200 or 300 yards, and by the entire want of discipline maintained on the line, by which an engine-driver is permitted to disregard danger-signals with impunity. If such regulations are allowed to be broken, and remain unpunished, when no accident occurs, as in the 99 cases out of the 100, they should not be appealed to in the 100th when some mishap takes place."

"*Sept.* 21*st*, 1861.—I am bound to say that rules, which are violated every day in the working of a railway, should be revised, as it is useless to appeal to rules when the practice is all against them."*

Railway Diplomacy.—With a case so clear, and a need so urgent, it may seem strange that no independent member has endeavoured to introduce some protective and penal measure. But the subject affords no political capital, and there is no influential class to recognize the champion of their grievance. On the other hand, the political management on behalf of the railways is so cleverly conducted that no party, political or otherwise, ventures to suggest such legislative control as shall efficiently protect the public and throw responsibility where it should lie. For the extent of the influence exercised on behalf of what is known as the "railway interest" is so great, and the organization so perfect, that royalty is the only estate of the realm not subjected to it. In the House of Lords, fifty railways have directors, who, necessarily, vote and speak under the influence of the prompt-

* All these dated extracts are from published reports of the inspectors appointed by Government, and whose great acquirements and judgment are acknowledged by all scientific men.

ings of their colleagues. In the House of Commons, one hundred and twelve members are directors, representing one hundred and sixty-five railway boards. That some of them know little or nothing of railway management is clear; and it may, therefore, be expected that it is not for possessing such knowledge they are chosen as directors.

Wheels within Wheels.—There are other influences also, of a far more mysterious kind. Enormous as is the amount spent in railway litigation, the "Parliamentary expenses," as they are called, include many sums of which the particulars are very vaguely set down. Up to the year 1857, twelve of the principal railway companies had spent between them upwards of five millions of shareholders' money—all included under the above vague heading. And the *Quarterly* thus alludes to the influences of which very long and careful scrutiny avails to reveal but a few of the ramifications:—

"The various companies command patronage, money, custom—all that confers power—to an extent previously unheard of in the history of associations. They have noble lords and honourable members for their active agents and astute rulers. They have opportunities of conferring advantages or of withdrawing them; of granting or withholding favours; of indulging in civilities, and of acquiring popularity, which they often employ to great advantage. United, they form a strong party in Parliament; separately, they have the issues of life and death pretty much at their disposal.

"To the tender mercies of this heterogeneous mass of companies are our 163 millions of travelling public turned over—a helpless mass. They are all, as a rule, equally ignorant of the condition of the engines and carriages, and of the line over which they are to pass; of the strength of the bridges, the efficiency of the signals, or the regularity with which they are worked; nor can they be aware of the thousand-and-one risks to which they are exposed."

Quarterly Reviewers' Suggestions. — The *Review* articles referred to very fairly represent the uneasy con-

dition of the public mind about railway management. Their conclusions as to the necessity for alteration coincide, but the means suggested differ widely. One insists on Government control; the other considers that a decided expression of public opinion would induce the necessary precautions to be taken. Now, we believe that these influences must be combined to produce any good effect. The pressure of public opinion may be efficient in inducing a temporary amendment; but when attention is diverted, the old course will be resumed. It is very evident, from what we have already stated, that legislative interference will never be attempted unless there is very strong pressure from without; but such control, once established over matters which concern the lives and health of railway travellers, would have the advantage of permanence and precision, and would define responsibility. But before any such authority is constituted, many a valuable life will be needlessly sacrificed; many a strong man's health will be crushed out of him, and the poor remainder of his life embittered by the effects of preventable railway accident.

Collisions.—Of 2,136 persons killed and injured on railways during four years (1857—60), 289 cases were attributable to trespass or suicide, and 111 to accidents at level crossings. These must be set aside as due to personal carelessness or folly. This would leave only 193 instances of death or injury not attributable to collisions, against 1,643 due to this latter cause, or seven-eighths of the whole number.

Their true Cause.—This ready but most unsatisfactory method of referring to collisions as the cause of accidents, instead of examining what caused the collisions, induced us to make further investigations, and these led

to startling revelations of the manner in which railway *employés* are kept continuously at work for periods beyond human endurance ; and hence the lives of passengers are continually endangered. For the guard and driver on the train, with the signal-man on the line, are the Parcæ to whom the lives of all travellers are confided. Yet, as we have pointed out, after careful inquiry both at home and abroad, these men are worked for many hours beyond the time that their faculties remain equal to the imposed strain, and hence arise a large number of the collisions, with their fatal results. The men know it, and have striven against the regulations in vain. There is the certainty of dismissal on complaint, but no opportunity whatever of redress or appeal.

Their Prevention.—To this unrecognized source of danger we at once directed attention, and shortly afterwards an edict was issued in France reducing the working time of railway *employés* from thirteen to eight hours per day ; and woe be to the company who shall disregard the imperial mandate ! But as the only despotic power in this country appears to be that of the "railway interest," it will, we fear, be very long before any similar restriction becomes law among us. From inquiries of the men themselves, we are led to believe that they would cheerfully accept a fixed time of daily work even longer than that adopted in France ; though one and all express the same significant wish for an occasional day of holiday and rest. They especially feel the hardship of making very long journeys without due intervals of rest between. From inquiries instituted on this point, we believe it to be especially important that there should be on every line (as already exist on one or two) a reserve of men ready in case of sickness or urgency to undertake those

extra duties, which are now shifted on to the first tired, hapless wight who may arrive in charge of a train.

Accidents from Wheels.—A second most important cause of peril to life and limb through railway accidents is the defective construction of wheels. This has been again and again urged by Government inspectors when tires flying off have led to serious mischief; yet the companies pay little or no attention. Remedies for the evil there are many, and no less than seven for which patents have been obtained. Each of these new wheels is of such construction that the tire cannot well fly off suddenly; and the best of them has been adopted in the recently-constructed royal carriage. This wheel was, we believe, invented more than twenty years ago; and its merits are just now recognized, when the safety of the Queen demands extra caution. For it appears that the railway companies have hit on a plan for avoiding alterations, equally discreditable and ingenious. They are willing—so runs the argument — to adopt any efficient plans, but just wait until some perfect one is devised: and, as there is no wheel-trade yet established with Utopia, life is still constantly endangered by the old arrangements. And here we come to another curiosity of railway management, little known to the public. The inventor of any patented article usually obtains reward for his ingenuity by a royalty on the sale from persons making use of his discovery. A number of ingenious improvements adapted solely for use by railway companies are yearly patented, and the system pursued towards the inventors is that, after approval of the plan suggested, it is determined to wait until the time of the patent expires before adopting it. Thus the old stock is used up and the royalty to the patentee saved; and, though a few more preventable

accidents may occur, yet the public are supposed to be used to being so treated, and the only anxiety is to keep the reports out of the papers, or to soften them as much as possible; hence the regular official letter which appears in the papers after such an accident, explaining that no one could possibly be to blame, and that the board are deeply grieved, &c.

SIGNALS.

A THIRD cause of danger to the passengers, and one which requires legislative interference, is the inefficient and irregular system of railway signaling adopted on most of the lines. As on the correct management of railway signals depends the safety of every train and its occupants, it is important that signals should be simple, uniform, and accurate. Their establishment was one of the first necessities recognized as essential to safe traffic on railways, and it might be supposed that here, at least, the lessons of experience had been turned to practical account.

SOURCES OF DANGER.—Why railway signals should be accurate needs no explanation. They require to be simple, because the men who tend them are necessarily not of the higher class of *employés*. And the signals should be uniform on all lines, because the signalmen, who, like guards and drivers, occasionally change from one company to another, may confuse the new and old regulations with disastrous results. This, unlikely as it may appear, is really an existing source of considerable danger: for a discussion is still going on as to the best system of of signaling,—whether it is preferable that the absence

of the signal shall indicate danger, or that the line shall be considered clear unless the danger-signal be displayed. These two systems—called negative and positive—are employed by different companies; and thus what indicates immediate danger on one line may be the safety-signal on another. The apparatus used also differs on different lines; though the semaphore, with movable arms closing like the blades of a clasp-knife, is so generally adopted, and found so simple and efficient, that its use throughout the country might be advantageously made compulsory.

Use of Colour-Signals, and Colour-Blindness.—But it is particularly important that the system of using coloured lights and flags for signaling purposes should undergo investigation and revision. The existence of colour-blindness among the men, with consequent inability to distinguish red (danger) from green (caution), can never be ascertained with that exactness which the risk demands. The affection is known to vary at different times even in the same person, and according to the distance of the coloured object; and men anxious to obtain employment would, of course, present themselves when at their best. It is well known to practical men that when an engine is travelling at high speed in the teeth of a sharp wind, or through rain or fog, it is difficult for the best eyes to distinguish the colour of a signal, especially if suddenly exhibited. Moreover, a red light, signifying danger, if seen from a distance, appears much further off than a colourless light side by side with it; and there is great reason to suspect that miscalculation of distance occurring in this way has caused several collisions. The eye, dazzled by the red glare of the engine fire on each opening of the furnace-door, is unable imme-

diately to recognize a small red signal or flag; but is liable, in obedience to the familiar optical law of successive complementary contrast, to see all things as if of a green hue. And the steam blowing off from the escape-valve (a medium through which the engine-driver often has to look) affects remarkably the colours of signals. Thus, the white becomes of an orange-red; the green assumes a dull and altered tint; and the danger-signal is so darkened when thus viewed that it is rendered almost invisible. It is also worthy of notice that the two colours, red and geen, used on railways, are the very worst which could have been selected. "At a distance they are mistaken by many who can distinguish them near. They are liable, when imperfectly illuminated, as in twilight, fogs, &c., to become altogether invisible; so that just when it is of greatest importance they should be seen, they are most liable to be misapprehended or not seen at all." *

Other Causes of Preventable Accidents. — There are two other fertile causes of preventable accidents which we believe also to demand legislative interference. One of these is the inefficient amount and action of the break-power supplied for arresting the momentum of a train. The other is the want of means of communication between guards and drivers. The Committee of 1857 recommended both these subjects as requiring attention, and the Government inspectors have again and again urged the necessity of some efficient control; but without any attention being paid to the recommendation.†

We have purposely confined our observations in re-

* Dr. G. Wilson on Colour-Blindness.

† Report from the Select Committee on Accidents on Railways.

ference to accidents to those varieties most prejudicial to public health and safety, and in which the necessity for immediate and decisive interference on the part of Government can be ascertained from official reports ordered and issued under Government auspices.

PUBLIC HEALTH.

The general and special influences of railway travelling as affecting health, and the remedies for those injurious results which we cannot hesitate to attribute to it, next claim attention. The effects differ in nearly every one of those persons who experience injurious results unmistakably attributable to the effects of habitual railway travelling; for there are very many, probably the majority, of travellers who feel little or no injurious effect from railway travelling, even though their journeys be almost daily and of considerable length. These represent a class of robust happy persons who are very dangerous in this, as in many other matters, to those more delicately constituted; for they boisterously pooh-pooh any attempt to remedy evils which they do not feel; and, by parading their own power of endurance, induce those who are less physically endowed to undertake what is beyond their strength.

Analysis of Effects. — Those effects on health which are clearly traceable to the influence of railway travelling differ both in degree and in character; for although there are certain symptoms which are nearly always present, yet no two cases are precisely similar throughout. Now, setting aside for the present all persons suffering from local disease, we are enabled to

recognize a certain class of symptoms which, from the manner and history of their occurrence, we are justified in considering as attributable to the influence of travelling on railways as distinct from what other modes of conveyance produce, and from the known effects of any casual complications, such as anxiety, dyspepsia, chilled extremities, retention, retinal impressions, and the like. The symptoms are manifested through the nervous system chiefly, or through those physical conditions which depend on the perfect physiological balance of the nerve-forces for their exact fulfilment. They vary (in persons of very similar constitution) from simple irritability, restlessness, and *malaise* after long journeys up to a condition of gradually supervening paralysis, which tells of insidious disease of the brain or spinal cord, such as, in its most pronounced form, follows on violent shocks or injuries to the nervous centres. These latter are the symptoms which frequently ensue from the vehement jolts and buffetings endured during a railway collision. And to the same cause, diminished only in intensity, may be also referred the less formidable group of symptoms. It is to this which the evidence and cases adduced in these reports point as the chief source of mischief, and that most detrimental to travellers. For each of those short, sharp vibrations felt in a railway carriage (and of which the number in every hour amounts to upwards of 20,000) resembles, on a small scale, the jerk and violent motion produced by a collision, from which it differs only in degree. The extent is so far lessened that the elasticity of the voluntary muscles suffices to maintain the equilibrium of the body against the disturbing force, so that it moves only with the motion of the carriage. But the nervous centres slung within their bony cavities

have no such safeguard, as these latter move with the short, sharp jerk which pervades the carriage. And the effect of this motion thus directly affecting their contents may be estimated, when it is remembered that one of the most elaborate and beautiful adaptations among all the wonders which anatomy reveals, is that which provides a series of successive springs, in order that the nervous centres may be always guarded from the direct effects of sudden jerks. But for such provision, every bound of the stag, every leap of the horse, would inevitably produce spinal concussion.

This lands us at the most important of all the causes which affect the health of railway travellers—one which is, in great measure, peculiar to this mode of travelling. It also points out the principle to be kept in view for remedying the evil,—whether general, as applied to all trains, so involving modifications of the present carriage arrangements; or individual, as applied to the self-protection of each traveller.

The causes of the peculiar jerking vibrations experienced in railway carriages have been already clearly set forth; and the means whereby their influence may be counteracted can be expressed in one word—elasticity—the natural antagonist of jerk. The provision of a sufficient intervention of elastic materials reduces the movement, which in a springless railway waggon is inconceivably distressing, to a gentle swaying motion. The springs of railway carriages, the horse-hair seats (and the elastic floor of cork supplied to the new royal carriage), are recognitions of the principle, which the habitual traveller may wisely extend for himself by many expedients, if he keeps in view what he has to attain—elasticity. The mats so successfully adapted for

the Post-office travelling officials, made from thick sheets of india-rubber, set on edge, as it were, and united like a honeycomb, are excellently suited for the purpose here indicated, and will be found greatly to add to the comfort of travellers if placed beneath the seat-cushions.

Travellers' Expedients.—Other kinds of caoutchouc appliances will readily suggest themselves; but it is especially important to bear in mind that the chief source of the detrimental influences experienced by habitual travellers is the prolonged series of short jerks known as the "motion of the carriage," and that elastic intervention is the only remedy which it is in their power to apply; and if they place the cushions under-foot, pile the spare ones where they sit, or put up their feet on the seats, it is the fault of the companies in not providing that which competent authorities declare to be practicable—a system of transit free from the motions so unpleasant to all and so injurious to many. Persons who constitute the majority of habitual travellers are, for reasons already detailed, most likely to experience the latter effect.

The Causes of Injurious Vibration and their Remedies.—The causes which interfere with such a desirable condition of smooth travelling as that described above, begin even below the rails, and extend throughout the whole construction of the carriage. In referring briefly to these, it will be also expedient to point out other defects and their obvious remedies.

The Ballast.—The Dust.—The sunken foundations (technically called the ballast) on which rest the sleepers, and the props or cradles that support the rails, chiefly give rise to the fine dust which in summer-time so soon covers a traveller. It is evident that this latter evil

could be obviated by a smooth rolling motion, instead of that constant hammering during the passage of trains which now causes the dust to be driven up and to leave a space wherein the heavy sleepers, which should be rigid and motionless, can work freely; thus adding to the motion, and producing yet denser clouds of dust.

The Cradles.—The cradles which support the rails at short distances have the effect of wearing away the iron where it rests on them, until the rail works up and down in its bed as each train passes over it, thus producing its share of the jerking movement. In old and ill-kept lines this is very noticeable.

The Rails.—It may be doubted whether it is at all necessary that rails should be thus hung between props, instead of having such form and construction as to admit of continuous support on the foundations, like the street tramways. But assuredly the double-headed form of rail now employed is one perfectly unfitted for the heavy and continuous traffic which passes over it. Its form was adopted that it might be turned when the upper surface is worn. This was found (from the unequal wear of the rails already mentioned) so injurious, that the plan has been abandoned, under compulsion. Yet this shape of the rail, equally expensive and useless, is still retained, and even laid down on new lines.

The Wheels.—But were these causes remedied, we should still have a source of discomfort to passengers in the inefficient adaptation of the wheels to their purpose. They are fixed solidly to the axles, which, turning with them, must necessarily be always at right angles to the length of the carriage. It is, in fact, returning to the old

Roman wagons. These compelled the making of those long straight roads, of which numerous traces now exist, because they could not turn corners or go round curves, by reason of their fixed axles. The railway carriage is in much the same condition. In its constant passage over curves, it occasionally gets over the difficulty by going over an embankment, but usually compensates for deficient mechanical arrangment by grinding the flange of the wheel against the rail; and thus arises another cause of annoyance to the passengers, in that unpleasant jar which such a process produces.

Remedies.—That the wheels themselves, instead of being slices of solid rollers, may be constructed so as to be to some extent elastic, is the opinion of many practical men; and there is reason to believe that the destruction to the stock, and discomfort or injury to the passengers, which the above-mentioned deficiencies in construction or adaptation lead to, might be obviated if the skill and experience of those well acquainted with railway matters were directed to the subject; and this suggestion of a conclave of practical men to consider these and kindred matters is one which we believe it would now be most desirable to carry out for the benefit of the companies and of the public.

The Pace.—The first necessity, as we have said, is not to obviate the vibration, but to prevent its production. We believe that the high rate of speed now maintained on all railways is unnecessary; whilst the increased motion it produces, and the enormous wear and tear it causes, are absolutely injurious. Its diminution would increase the safety of travellers, and was one of the many important suggestions made in the Report of the Parliamentary Committee, not one of which has yet been

carried into effect. These included also the following recommendation :—

PUNCTUALITY OF TRAINS.—"Your Committee is of opinion that the perfect regularity in the time of the departure from and arrival at each station by the trains, which would appear to be a material element of safety in railway travelling, may be attained by legislative interference, to the extent of enacting that, except under exceptional circumstances, the public should have some means of obtaining prompt and cheap redress in the recovery of penalties in every case of want of punctuality in the departure and arrival of trains at every station." To business men travelling by rail such a regularity (or, indeed, any other) for ensuring punctuality would be a valuable boon. Absolute punctuality in arrival of trains is the exception, and not the rule ; and the anxiety and urgent hurry on arrival thus entailed on men of business especially tend to increase any ill effects that the long and rough railway journey may have produced.

We have intimated that the injurious influences clearly traceable and peculiar to railway travelling appear chiefly to arise from one source,—inefficiency of the machinery for the work it is intended to accomplish ; with a resulting series of short sharp concussions ; sometimes rendered still more injurious by circumstances peculiar to individuals, or by the conditions under which the journey is performed. The traveller's mind takes little note of the thousands of successive jolts which he experiences, but every one of them tells upon his body. So the pedestrian does not heed the effect that each step produces, but his tired limbs at the journey's end prove that due account has been kept of every one of them.

We have therefore followed up the causes which pro-

duce this injurious degree and kind of motion; for we believe that, if this were obviated, the majority of those who now experience ill effects from railway travelling would be relieved from that which chiefly causes their suffering. But there are many other things also in the management of the passenger traffic on railroads, reform of which would vastly conduce to public health and comfort.

The carriages generally in use on railways curiously illustrate our natural tendency to conservatism. At first they were merely a number of mail-coach bodies, joined together, and put on a short supply of wheels. The remarkable facilities for adding to the comfort and ensuring the safety of passengers which this mode of travelling affords seem to have been altogether disregarded, most of the old coach inconveniences being carefully preserved. There has been no notable improvement on many lines up to the present time, but by degrees the dangerous plan of having only four wheels, in place of six or eight, has been discarded. The narrow-gauge carriages have increased five feet in length, a foot in width, and eighteen inches in height; and on some of the lines they are now introducing carriages nearly as long as those so successfully used on the American railroads, which are from thirty to forty feet in length. We believe that a very considerable advantage, both to the companies and to the public, would ensue if the internal arrangement of carriages were also approximated to that which obtains on the other side of the Atlantic.

Long Carriages.—On this plan, the whole length of each carriage (stalled off somewhat like the boxes in a coffee-room) would be open, with a passage in the centre, and a platform at each end for exit or entrance—the

passenger-guard having thus free access from one end of the train to the other, through the centre of the carriages. The objection to such an innovation as being opposed to our national prejudices is too trivial to need refutation. Indeed, it may be doubted whether that conceited spirit of exclusiveness, that unwholesome mistrust of our neighbours, peculiar to the travelling Englishman, is ever a healthy feeling to foster or encourage.

ADVANTAGES GAINED.—In long carriages with many seats, and a passage in the centre for a guard, there would be no possibility of injuring cushions or glass, of card-sharping, of insults to female passengers, or of being condemned to the sole company of a disagreeable person —whether intoxicated, insane, or impertinent.

SAFETY.—Such an arrangement would afford to timid persons that sense of security which they always derive from the presence of numbers, and would prevent the distressing effects of retention (as in persons with spasmodic stricture, &c.), since there could be conveniences fitted at the end of each carriage. Moreover, there would be assurance of ready communication between passengers, guard, and engine-driver; the stopping to collect tickets would be done away with; and, in case of the engine leaving the rail, carriages of such length would be far less likely to follow than the short-bodied vehicles which now fly over so readily. Experiments instituted for the purpose have already proved that carriages of this length, even with the present imperfect under-works, are more free from both vibration and oscillation than those in ordinary use.

ECONOMY.—There would be economy to the companies and advantage to the public resulting from such an arrangement. There would be no mechanical difficulties

to overcome, since the plan has been fully tested and found to succeed. The increased width required on our narrow-gauge lines would be afforded by extending the carriages over that space now allotted to the steps; and if central doors were provided (for rapidly emptying the carriage in case of accident), the expedient of a step opening with the door, as in a well-finished brougham, might be adopted.

Temperature.—There are probably more colds caught at railway-stations than in any other buildings, and it is remarkable to what extent travellers avail themselves of the railway arrangements for their discomfort. After becoming heated by previous sharp walking, they loiter on the platform, oftentimes in a cutting wind, to wait for the train—"Hinc illæ lachrymæ." There is no reason why a fixed time, say two minutes, should not be allowed at every station, with a longer period, as now, at junctions, &c. With such provisions to prevent unnecessary hurry, passengers might be kept within doors at the stations until the platform door opened on arrival of the train.

The extremely rapid diminution of temperature during cold weather in railway carriages proceeding at high speed is necessarily peculiar to this mode of travelling, and therefore requires to be specially guarded against. It is greatly accelerated when there is a high wind, which, in itself, also exercises considerable influence on a train, and has been in some cases the cause of accident, sufficient allowance not being made for the propulsive force of a wind astern. Diminution of the number of separate carriages, and the adoption of rounded ends like the stern of a ship, would lessen expenditure by diminishing the amount of traction-power required and of fuel consumed.

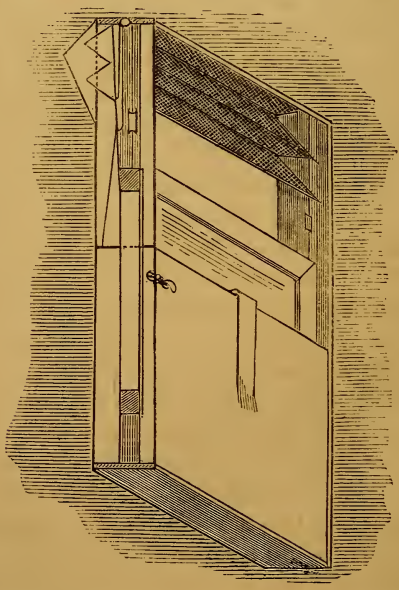
Cold Weather.—The low temperature of railway carriages in winter, with the sore inconvenience, or even injury, thence arising to delicate persons, should be obviated by foot-warmers regularly supplied, as on the continental lines, or by establishing communicating pipes from the engine to the end of the train; so warming the whole length by hot air. Passengers should neither be required to ask nor (worse still) to pay extra for what is an absolute necessity to health in travelling during very cold weather. With the long carriages, an arrangement of hot-air pipes could be easily effected. At present, passengers try to avoid the inconvenience of chilled extremities by elevating their feet on the opposite seats, destroying and dirtying the cushions, &c. But the same purpose would lead them to retain their feet on the floor, if the means of heating above recommended were supplied.

Hot Weather.—Another very desirable improvement for travellers' comfort would be the provision of double roofs with cellular intervals to all carriages. This would be beneficial both in winter and summer. But during the latter time, when the sun beats fiercely on the roof, the heat becomes intense, as most travellers know, often being ten or twelve degrees above that of the external air. This expedient has already been adopted in some few instances, and we are informed that the resulting increase of comfort to passengers has been considerable.

Ventilation.—The ventilation in railway carriages has been already shown to be defective in principle, and to exert injurious influence on the health of passengers. The following suggestion accompanied the valuable communication of Dr. Angus Smith on this subject:—"If the air were supplied by a wide tube opening forwards, placed beside the engine, and running along all the

train, this would effect ventilation without draught, and keep out the dust. The tube could be fitted to each carriage, and no joining would be required, as it need not be air-tight, since the force of the moving train would suffice to impel the air into every carriage. The air would be taken at the front of the engine, where there is no dust, and the draught would be made almost imperceptible; it would be brought to each passenger pure, without incommoding his neighbour. The plan would be easy and inexpensive, and the putting together of a train would not be at all affected by it."

PLAN RECOMMENDED.—After careful examination of



many remedial plans suggested, we consider that a modi-

fication of that system of ventilation now so successfully adopted in many of our hospitals would be most advantageous. In its crude form (as used in hospitals) it depends on the diffusion of currents of air, by causing them to pass through perforated zinc plates. This system of ventilation has been most ingeniously adapted to ordinary requirements by Mr. William Cooke, C.E., of Spring-gardens, and especially for use in barracks, large dormitories, &c., where it is particularly suitable. He employs copper-wire gauze, and his special adaptation of the principle for railway carriages is very simple and efficient, fulfilling two most desirable ends—ventilation without draught, and exclusion of dust. The glass window of the carriage, as it descends, carries with it the wire-gauze folds represented in the engraving on the previous page, and these so nicely shut together when the window is closed that no air can then enter. But when the window is pushed still further down, the folds of gauze, by a simple arrangement, begin to ascend, so that the whole aperture is as free as at present by the time that the glass window has entirely descended.

Lighting of Carriages, etc.—The expense attendant on the trimming, filling, and shifting of the dim oil-lamps now used in our railway carriages would be saved if the plan recently proposed of lighting the whole train either with ordinary gas or inflammable vapour were adopted, since the jets in each carriage would need no shifting. The improved light would add much to the convenience of passengers, and a large burning-pipe attached to the reservoir would supply a most valuable danger-signal in case of the train breaking down. It has also been suggested—and we believe the plan would be most acceptable to ladies and nervous travellers—that all tunnels

should be lighted throughout on the same method. As the entrances are always visible for some considerable distance along the line, the turning out of these lights would afford an unmistakable signal of danger.

NAMES OF STATIONS.—Amongst railway passengers there are, necessarily, numbers of persons who are partially or altogether deaf. Such folks become nervous and fidgety as they approach their destination, since they do not hear the names of the stations called out. Nor, indeed, is it always easy to understand what the sounds mean which railway porters, with strong provincial pronunciations, emit. In Wales it is a standing joke with tourists to guess how the noise they hear would be spelt. A simple remedy, costing little, and saving much inconvenience, would be to have the name on the bands of the porters' caps at stations, like the name of their ship on the caps of sailors. And it would conduce much to the convenience of passengers if, on some prominent part of the station, there were roughly frescoed a plan of the neighbouring town or country.

PATHOLOGICAL SUMMARY.—It is unnecessary to do more than allude to the accumulated evidence which accomplished observers of health and disease have contributed to our report on the influence of railway travelling on the various organs and parts of the body in health and disease.

The efficiency of the rapid concussions incidental to railway travelling in developing or aggravating epilepsy, clonic spasm, cerebral softening, and spinal softening, has been studied, not by the light of vague conjecture, but upon the authority of strictly-observed cases in the practice of Sir Ranald Martin, Dr. Brown-Séquard, Dr. Radcliffe, Mr. Ernest Hart, and others. The particular influ-

ence of cold and draught has been brought out prominently by Dr. Williams ; while this has been placed in necessary juxtaposition with the exact inquiries as to ventilation and relative purity of the air in railway carriages by Dr. Angus Smith. The mischief following from undue retention of the secretions is sufficiently and practically illustrated in the case by Mr. Hilton. The nature of the impressions on the eye so well studied by Sir David Brewster has been traced to its pathological consequences by Mr. White Cooper. Dr. Fuller's ingenious observations on the part played by the auditory nerve in conveying to the brain strong and incessantly repeated impressions of sound, are of a practical and suggestive character. This is, no doubt, one cause of the peculiar effects of continued railway travelling which had not been well known, and of which the mischief is preventable. The almost certainty with which a long railway journey will, in some pregnant women, produce abortion, has been well illustrated in the communications by Dr. Meadows and Dr. Graily Hewitt. The acceleration of the pulse in railway travelling is one of the indications of the extent to which this form of passive exercise taxes the system ; but all physiological deductions require to be received with great reservation, as the disturbing elements are so many and various.

There are only two classes of persons especially likely to be injuriously affected by moderate railway journeys, even though frequent : they are persons advanced in life and of weakened power, and those who are subject to the special diseases which have already been studied in this relation. The actual exertion, the excitement, the mental strain, the peculiar influences of the motion of a railway carriage, indicate its dangers to those first mentioned.

These constitute a small minority. But there are a number of persons who, although not far advanced in age, are yet the subjects of various conditions of ill health depending on insidious degenerative disease of the brain and heart. The season-ticket holders of the railways are, in large numbers, men who have passed the best years of their life in hard and exhausting employment of mind and body. They are the successful merchants; the senior partners of flourishing firms, which they have built up by a life of labour; half-retired tradesmen; half-invalid bankers, *et id genus omne*. We can now see that it is by the injuries which have resulted to these men from their constant travelling to and from town that an impression has become current as to certain mischiefs which habitual travelling inflicts. When it was known that such a banker, who comes up fifty miles three or four times a week, has to lie down half an hour before he can sign a cheque; that such a well-known chemist has suffered from symptoms of brain excitement since he bought his new house by the sea and travelled daily to London; or that a certain barrister has found himself obliged to pay for his journey by epileptic seizures, the alarm soon extended beyond reasonable limits. But few men can endure without suffering to travel fifty or a hundred miles daily to their business for any length of time. The influence of the journey itself is heightened by many accessory conditions to which we have adverted; and the present construction of the rails and carriages is such as to deprive the traveller of all those mitigations by which his discomfort might be diminished and his health safeguarded.

Catching the Train.—Amongst the unprecedented collection of cases brought under our notice during this

inquiry, there have been recorded several of serious mischief, and even death, from persons in ill health hurrying to catch trains, and sitting down, heated and breathless, in the draught caused by the moving of the train which they have just managed to be in time for. It is almost exclusively at large termini that these cases have occurred, and that the cause of them obtains. Now, this rushing in at the last moment, we are informed, is becoming more frequent; and consideration of the condition in life of those who constitute the majority of season-ticket holders would indicate how this evil arises. We believe it would be advantageous to public health and safety, however harsh it may at first appear, that the doors at termini should be closed five minutes previous to the departure of each train, so that sufficient time should be allowed for passengers to quietly settle themselves, and also for the officials, who are often (as one of them graphically expressed it) "torn to pieces" just at the last moment. It is well known that the difficulties with luggage, which this arrangement would obviate, are frequently causes of delay in starting trains. Then there is high speed to make up lost time or want of punctuality, both of them fraught with danger to passengers.

Cautions to Habitual Travellers. — It has been shown that the injurious effects which habitual railway travelling produces on some who escape such influences when only taking occasional journeys are very marked. In such persons, heedless continuance comes to be a cause of disease. In some, there have been no previous symptoms that they could recognize, or such as would have deterred them from undertaking the daily journey; and thus the season-ticket is taken, and has soon to be disused, or the health suffers. In all cases the evidence points to

the conclusion that the injurious influence slowly and gradually increases whilst the cause remains—that tolerance is not established by persistence.

It is too much the custom, when adopting a country residence on a railway line, to make no new arrangements of business according to the diminished time for work which the daily interval between the morning and evening trains allows. Hence that hurry, anxiety, and working of the brain at high pressure, which of all things tend to develop in susceptible persons such injurious effects on health as habitual railway travellers often experience. The remedy for this is obvious : "Cut your coat according to your cloth"—" Mene tenus proprià vive"—" Selon le pain il faut le couteau,—" are saws proved to be wise. But we believe that no person is justified in undertaking a series of continuous journeys by rail under the conditions alluded to (if under any circumstances), without previously consulting his medical attendant as to their probable effect on his health, the precautions he should adopt, and the warning symptoms which he may not safely disregard. In aid of such decisions, we trust that these reports, now brought to a conclusion, may prove helpful.

THE END.

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